DOCUMENT RESUME

ED 201 237 HE 013 689

AUTHOR Hawley, John B.
TITLE Riding the Kondratieff Wave with the Liberal Arts and Sciences.
PUB DATE 20 Mar 81
NOTE 82p.: Paper presented at the Annual Meeting of the American Educational Research Association (Los Angeles, CA, April 13-17, 1981).

EDRS PRICE MF01/PC04 Plus Postage.
DESCRIPTORS Business Cycles; Economic Development; Economic Factors; Educational Development; *Educational History; General Education; *Higher Education: History; *Industrialization; Innovation; *Liberal Arts; *Sciences; Social Change; Technological Advancement; Technology; Theories; *United States History
IDENTIFIERS Kondratieff Waves; *United States

ABSTRACT

The major elements of the Schumpeterian schema are examined, and events in the development of higher education in the United States are plotted on the Kondratieff Waves, with special reference to the evolution of liberal education and the sciences. It is suggested that the liberal arts, which had great impact in the 17th century, declined after the first industrial revolution, creating the first Kondratieff Wave and the growing dissatisfaction with the classical curriculum and literary colleges. The second industrial revolution associated with the railroads in America and the Darwinian revolution, turned to the sciences as a major influence in higher education. The third industrial revolution, under the impetus of electrification and petroleum and related industries, created the third Kondratieff Wave and strengthened the hold of science and technology on American society. The general education movement was also born to modernize liberal education. The fourth Kondratieff Wave, created by the post-industrial revoluation with the influential computer, communications, aviation, and space industries, further solidified science and technology in the curriculum. It is suggested that there seems to be a trend in the direction of a return to the traditional values of general education, and that the downgrade of Kondratieff IV is the time to initiate innovations necessary for the survival of a society committed to science and technology. Graphs and listings of events by year illustrate both societal cycles and those in higher education. (SW)

**********
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
**********

U S DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

John B. Hawley

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

# RIDING THE KONDRATIEFF WAVE WITH THE LIBERAL ARTS AND SCIENCES

by

John B. Hawley
Department of Higher Education
Southern Illinois University at Carbondale

ED201237

## Contents

| | |
|---|---|
| Introduction | 1 |
| Schumpeter's Capitalist Process | 2 |
| Applications to Higher Education | 19 |
| The Undergraduate Curriculum | 24 |
| Kondratieff I (1790-1842) | 52 |
| Kondratieff II (1843-1896) | 59 |
| Kondratieff III (1897-1953) | 67 |
| Kondratieff IV (1954-2010) | 72 |
| Summary and Prospects | 76 |

## Figures

| | |
|---|---|
| A - Schumpeter's Trilogy of Cycles | 4 |
| A'- Phases of the Kondratieff Wave | 5 |
| B - Carrying Mechanisms of Prosperities | 7 |
| C - Economic Depressions | 9 |
| D - Money Prices | 11 |
| E - Producers Price Index | 12 |
| F - Tariffs | 13 |
| G - Wars | 14 |
| H - Presidents of the United States | 15 |
| I - Nicknames of Decades | 16 |
| J - Types of Institutions which began Undergraduate Instruction, 1636-1976 | 20 |
| K - Number of Colleges which began Undergraduate Instruction, 1636-1976 | 21 |
| L - Percentage of Colleges which began Undergraduate Instruction, 1636-1976 | 22 |
| M - 81 Events in the Development of the Liberal Arts | 28-39 |
| N - 85 Events in the Development of Science and Technology | 40-50 |
| NUMBER AND PERCENT OF NEW ACADEMIC ENTERPRISES | |
| O - Medical, Pharmacy, Dentistry, Nursing, and Public Health Schools | 53 |
| P - Engineering, Architecture, and Mining Schools | 54 |
| Q - Graduate Schools | 61 |
| R - Agriculture, Home Economics, and Veterinary Schools | 62 |

HE 013 689

March 20, 1981

# RIDING THE KONDRATIEFF WAVE WITH THE LIBERAL ARTS AND SCIENCES

John B. Hawley
Southern Illinois University at Carbondale

In 1972 watching The Today Show I first came across the Kondratieff Wave in the title of a book about to be published (James B. Shuman and David Rosenau, The Kondratieff Wave, New York: World Publishing Company, 1972). Several years later I read David Riesman's statement that "When one tries to look at the whole academic spectrum in America, one wonders whether movements for reform may not bear some resemblance to the boom and bust characteristic of the business cycle" (David Riesman et al., Academic Values and Mass Education, New York: McGraw-Hill, 1970, pp. 285-286). In his now almost forgotten Business Cycles: A Theoretical, Historical, and Statistical Analysis of the Capitalist Process (New York: McGraw-Hill, 1939), the late Harvard economist Joseph A. Schumpeter (1883-1950) showed that the Kondratieff 50-60 year long cycle and the 3-5 year Kitchin or business cycle are the longest and shortest, respectively, of three fluctuations which have occurred concurrently as the U.S. capitalist economy has evolved since 1790. The notion that history repeats itself and the concept of cycles are both ancient. The literature of business cycles and economic fluctuations is vast, yet

their application to the history of American higher education is relatively novel.

This paper will give an overview of the major elements of the Schumpeterian schema. It will "plot" events in the development of higher education in the United States on the Kondratieff Waves, with special reference to the evolution of liberal education and the sciences.

## Schumpeter's Capitalist Process

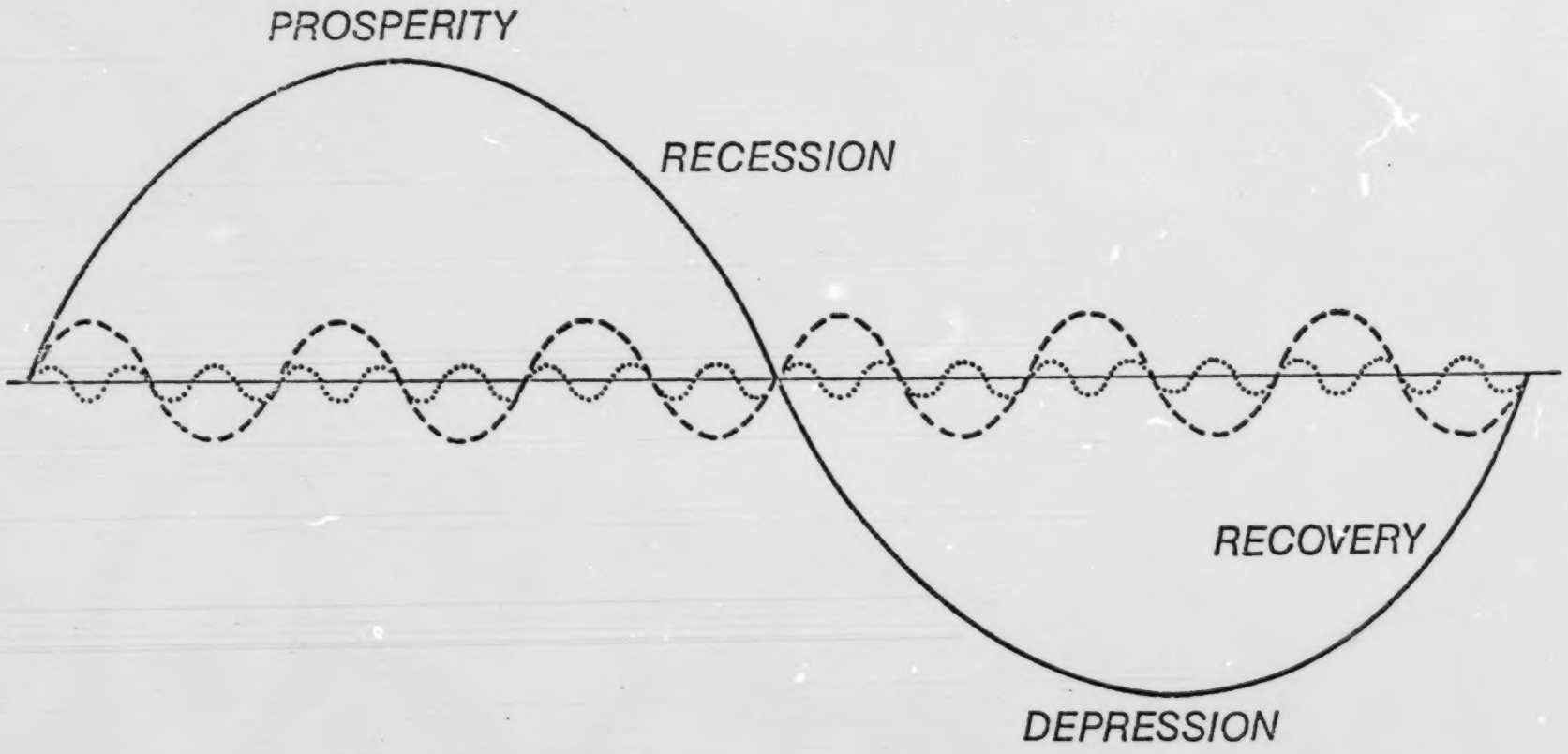
Schumpeter parted with the neoclassical economic equilibrium tradition which viewed capital accumulation as being essentially smooth and continuous. His theory of economic change saw capitalist economic development as necessarily an interrupted and lurching process that inevitably occurred in long wavelike fluctuations which he called "Kondratieffs" after their discoverer, Nicolai D. Kondratieff, A Russian agricultural economist (1892-1932).

Since 1790 the United States has experienced four Kondratieffs, each of which Schumpeter viewed as an industrial revolution in itself. "The capitalist achievement does not typically consist in providing more silk stockings for queens but in bringing them within reach of factory girls in return for steadily decreasing amounts of effort," he wrote in his celebrated Capitalism, Socialism and Democracy (New York: Harper and Row, 1942, p. 67).

> These revolutions periodically reshape the existing structure of industry by introducing new methods of production--the mechanized factory, the electrified

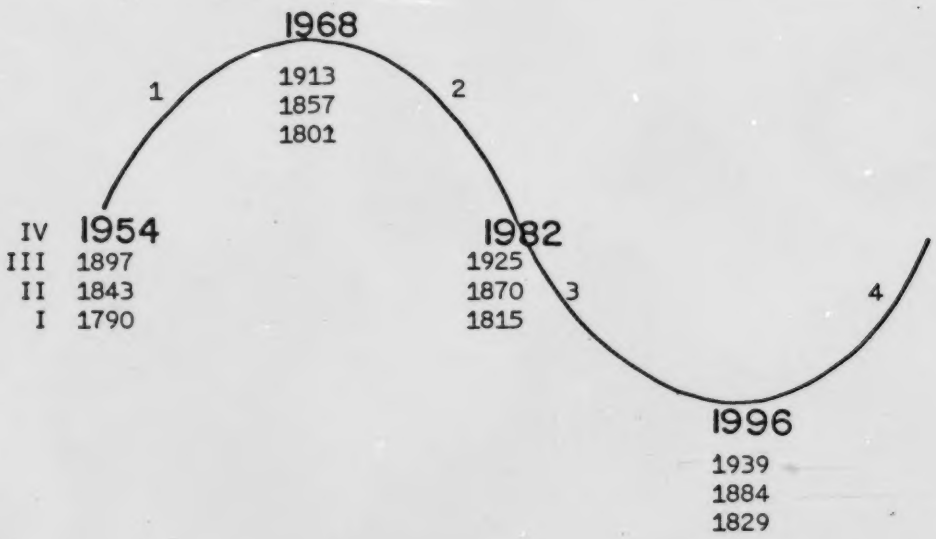
> factory, chemical synthesis, and the like; new commodities, such as railroad service, motorcars, electrical appliances; new forms of organizations--the merger movement; new sources of supply--La Plata wool, American cotton, Katanga copper; new trade routes and markets to sell in and so on. This process of industrial change provides the ground swell that gives the general tone to business: while these things are being initiated we have brisk expenditure and predominating "prosperity"--interrupted, no doubt, by the negative phases of shorter cycles that are superimposed on that ground swell--and while those things are being completed and their results pour forth we have elimination of antiquated elements of the industrial structure and predominating "depression." Thus there are prolonged periods of rising and falling prices, interest rates, employment and so on, which phenomena constitute parts of the mechanism of this process of recurrent rejuvenation of the productive apparatus. (Ibid., p. 68)

Figure A shows Schumpeter's trilogy of cycles, the short, intermediate, and long waves, existing simultaneously and concurrently. Figure A' presents the upswings and downgrades of each in four phases, Prosperity, Recession, Depression, and Recovery. Economic growth in Schumpeter's view was rooted in the turbulence of cyclical movement which occurred as the result of innovation, the primary force causing the economy of competitive capitalism to fluctuate over the 50-60 year period or "long wave." According to Schumpeter, "innovation" is the commercial application of a cluster of technological, organizational, and procedural changes to the production of goods and provision of services that moves the economic engine off equilibrium and into the upper half of the upswing, or Prosperity phase, of the cycle. Innovation is the major internal element in the economy. A broad economic and sociological process, it


PROSPERITY
RECESSION
RECOVERY
DEPRESSION
KONDRATIEFF (54–57 years)
JUGLARS (8–10 years)
KITCHINS (40 months)

PHASES OF THE SCHUMPETERIAN KONDRATIEFF WAVE

A'

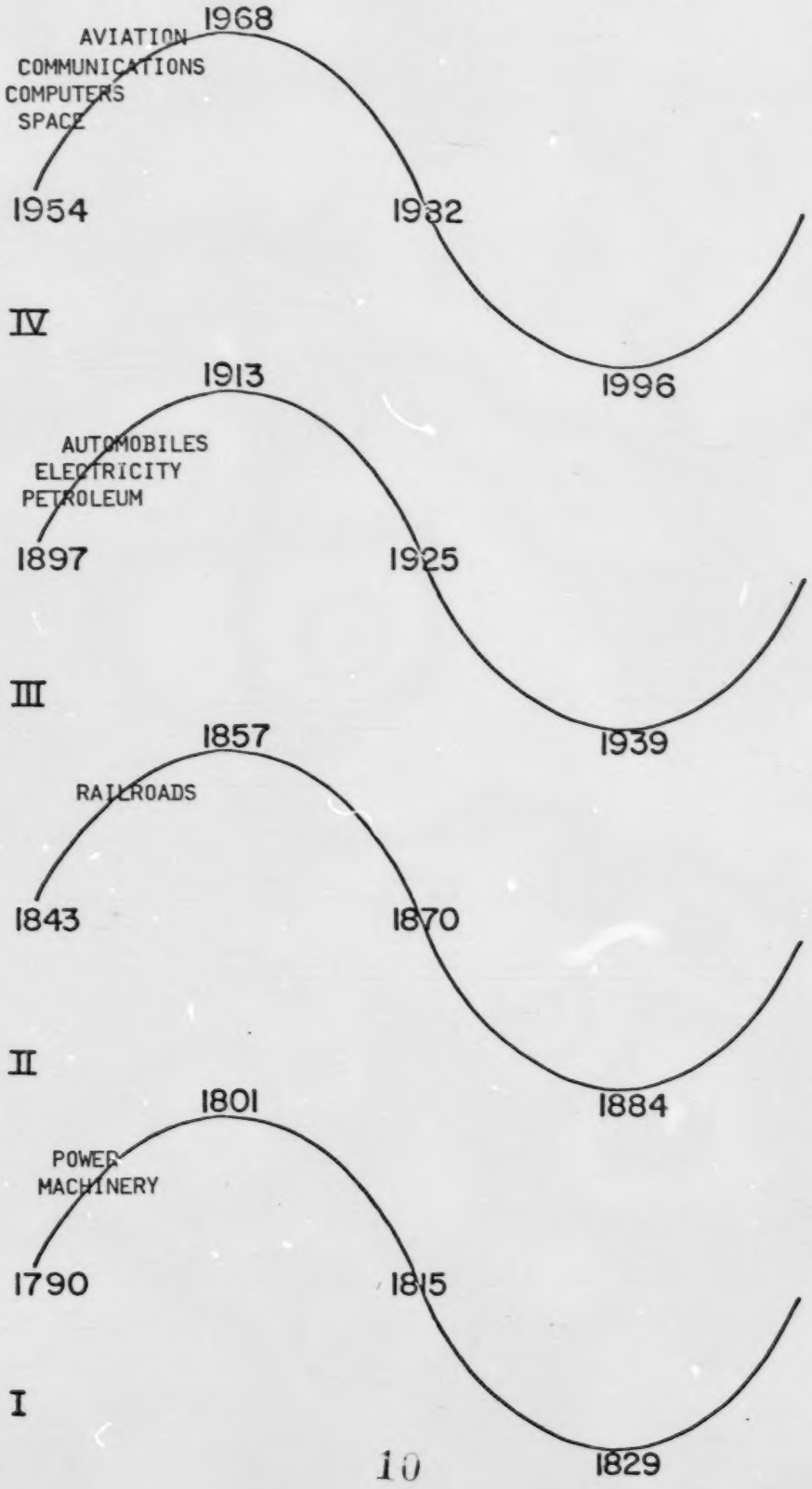



CODE: 1 = Prosperity — UPSWING = 1 and 4
2 = Recession
3 = Depression — DOWNTURN = 2 and 3
4 = Recovery

causes economic change; at the same time, it causes clusters of major and minor innovations to "ignite" and become part of the economy. Schumpeter believed that changes in taste, in ways of making things, and especially in methods of supplying goods are what causes entrepreneurs to innovate. Major innovations are the "backbone" of each Kondratieff. Figure B shows the groupings of major innovative industries which "carried" each of the four Kondratieff upswings during the Recovery phase of one cycle and the Prosperity phase of the next. When these innovations have run their course, the economy enters the Recession phase, which may be likened to a "spring cleaning" to get rid of obsolescent and inefficient technologies, organizations, procedures, and processes. If the cleansing process is not completed during that period, the economy may be forced off equilibrium again and into Depression until the job of spring cleaning is accomplished. During the Recession and Depression phases, innovators and entrepreneurs become especially aggressive and competitive in their struggle to initiate or "ignite" innovations and insert them into the system.

Minor or secondary innovations, on the other hand, may occur at any point in the cycle, on upswings as well as downturns. In short, like a roller coaster, the capitalism mechanism on a Kondratieff Wave gathers momentum as major innovating industries are established in the downsweep of Recession and Depression, only to rush headlong, and often madly, with tremendous force up the steep incline of Recovery and Prosperity, gradually

CARRYING MECHANISMS (BACKBONE INDUSTRIES) OF PROSPERITIES B

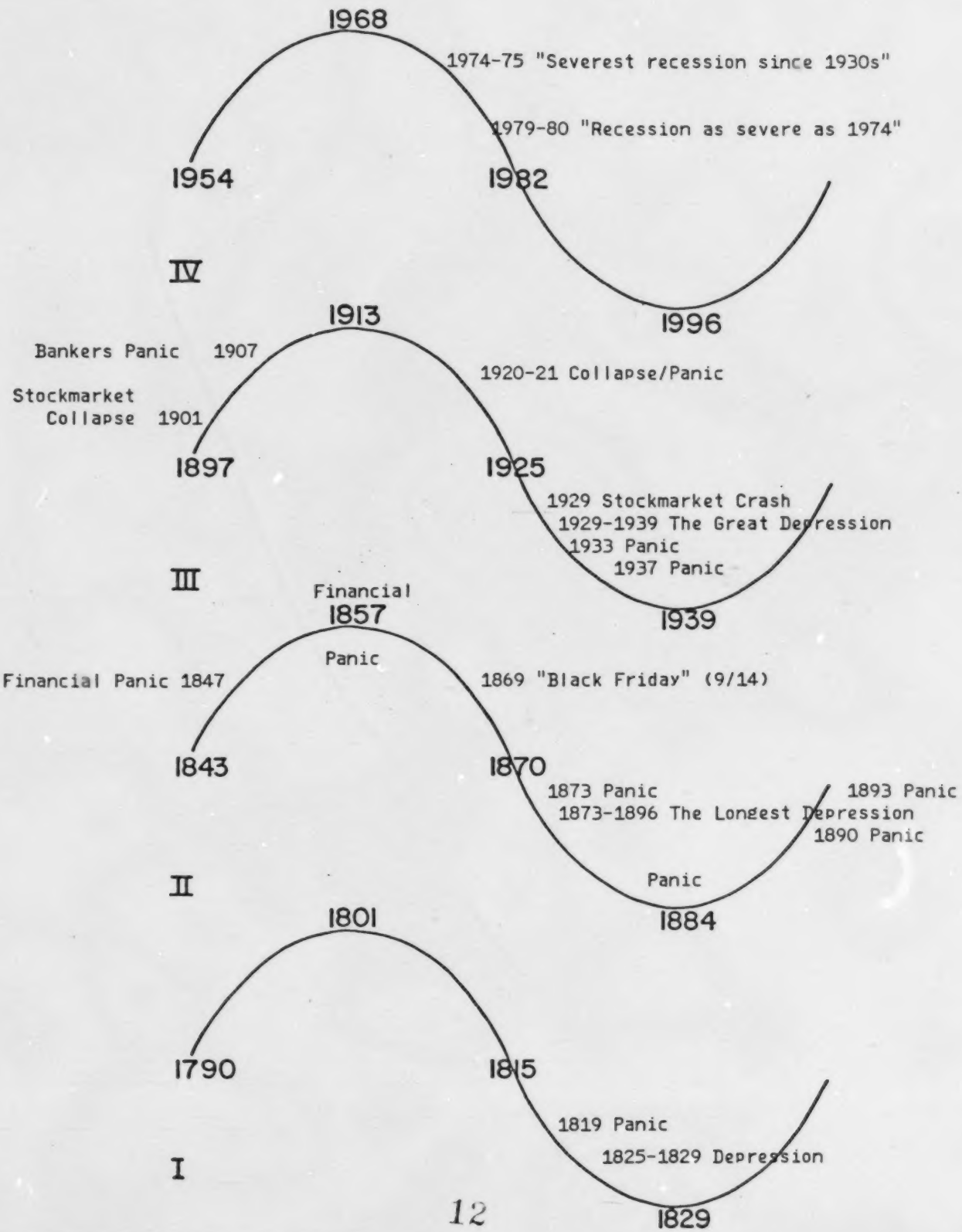


losing energy while poising suspended at the peak before the next precipitous drop towards innovation and experiment. Turbulence is the norm for the economy and society as the economic machine moves into Prosperity as well as into Depression.

Figure C shows the times when the antiquated and senile elements of the industrial structure were eliminated and the rejuvenation of the productive apparatus began, that is, the downgrades in the Recessions and Depressions of each Kondratieff.

Schumpeter took for granted that wars and revolutions, as well as taxes and crop variations, affect the capitalist economic mechanism. These he called "external factors" since they do not cause major innovations but usually only accentuate trends already present in the economy. Figures D through H show some of the external factors and characteristics plotted on the Kondratieffs since 1790. Each has its own pattern or lack of pattern as the case may be. Kondratieff upswings show consistent rises in Prime Interest Rates (Fig. D) while downgrades present a mixed picture. The Producers Price Index (Fig. E) rose during all four Prosperities and Recessions and fell during all three Depressions to date, but has shown no consistent pattern during Recoveries. As one should expect, tariffs (Fig. F) generally, but not always, rose during downgrades and fell during upswings. Wars (Fig. G) have occurred in all four waves during Prosperities and Recessions but not

ECONOMIC DEPRESSIONS AND FINANCIAL COLLAPSE, CRASHES, CRISES AND PANICS



during Depressions. Only in one of the three previous Recovery phases was there a war. The relationship, if any, between wave phases and political climate can be inferred from Figure H. Finally, it is interesting to note that, on the whole, the downgrades have tended to be labeled with nicknames such as the "Roaring Twenties" or "Gilded Age" (Fig. I), whereas upswings have not been so blessed.

In this observer's opinion, actually only two stages in each wave have appeared to behave as one would expect, given their names: Prosperities have generally displayed characteristics such as growth, inflation, wealth, and well-being. Depressions have generally demonstrated features such as contraction, decline, devaluation, deflation, hard times, and impoverishment. On the other hand, the other two phases have appeared somewhat differently from what one would expect, given their designations: Recessions have felt and seemed to be more prosperous and Recoveries have looked more depressed than might be anticipated:

PROSPERITIES[1]

I (1790-1800) had substantial prosperity with one minor recession from 1796-1798.

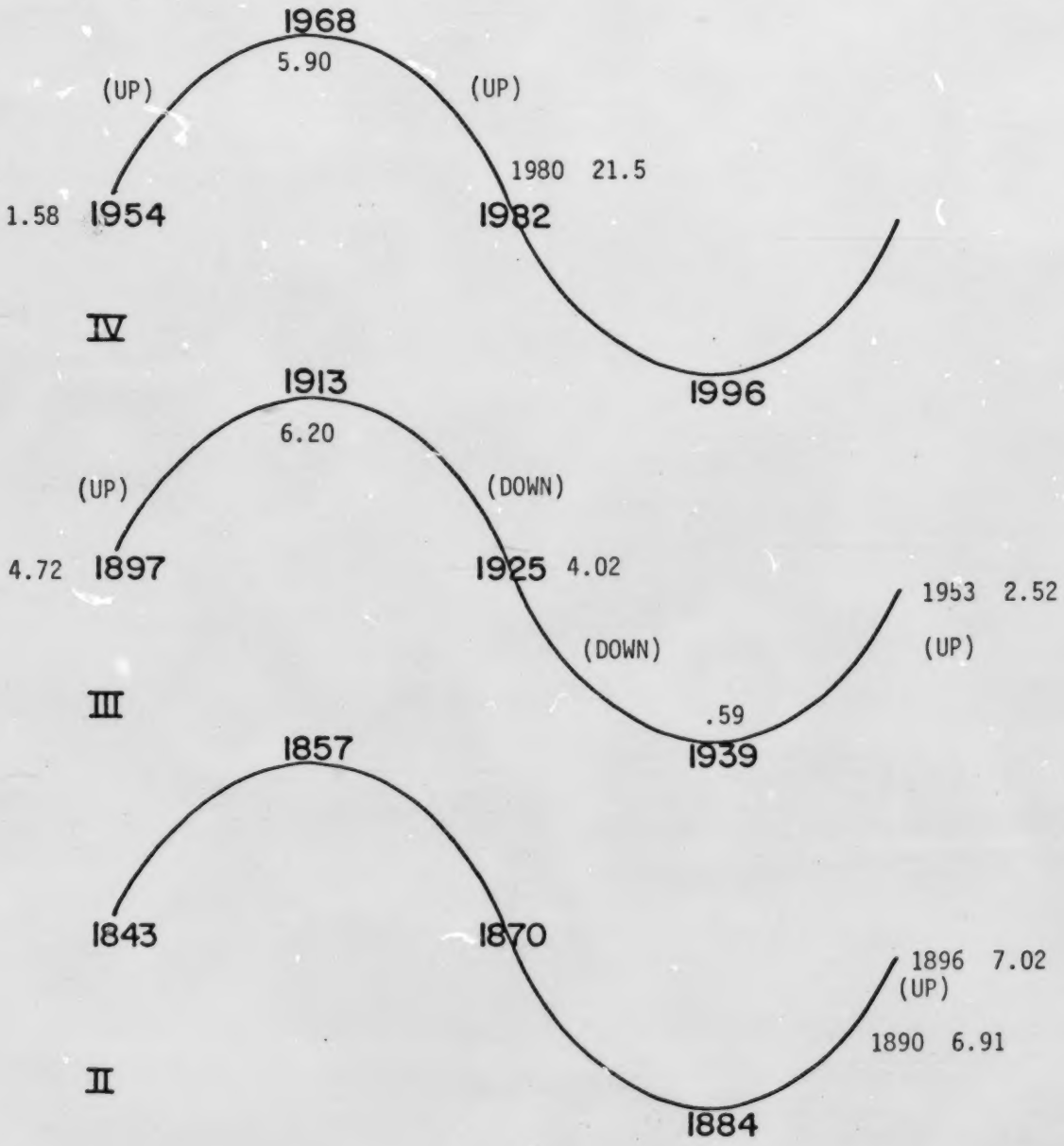
II (1843-1856) started with a gradual recovery from 1844-1848 which was followed by a marked expansion of business from 1849-1856.

III (1897-1912) opened with a rapid recovery with continuing prosperity except for brief financial crises in 1903 and 1907, a recession in 1910-1911, and a downturn on the eve of World War I in 1913-1914.

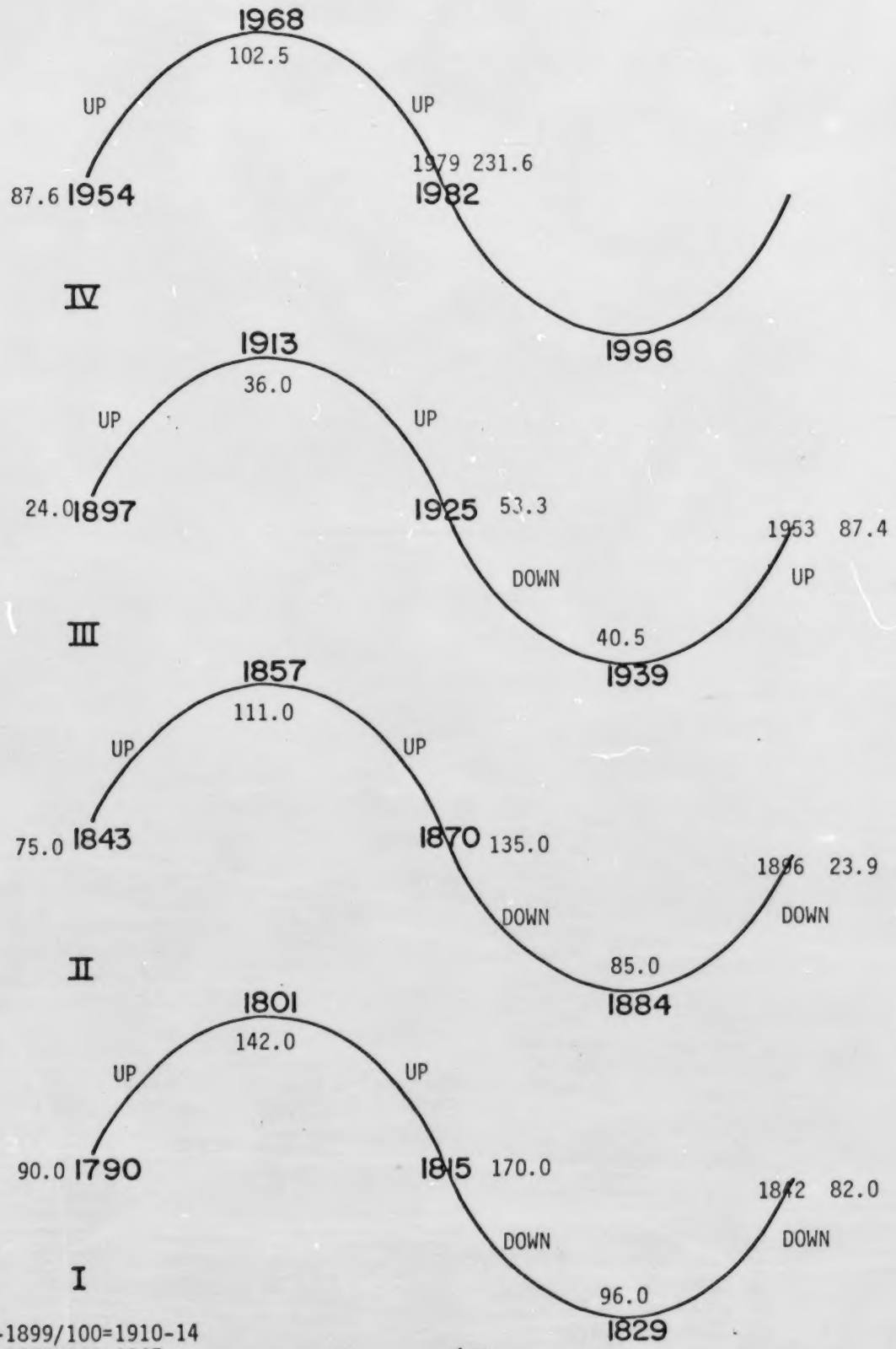
D

MONEY PRICES

Prime Interest Rates

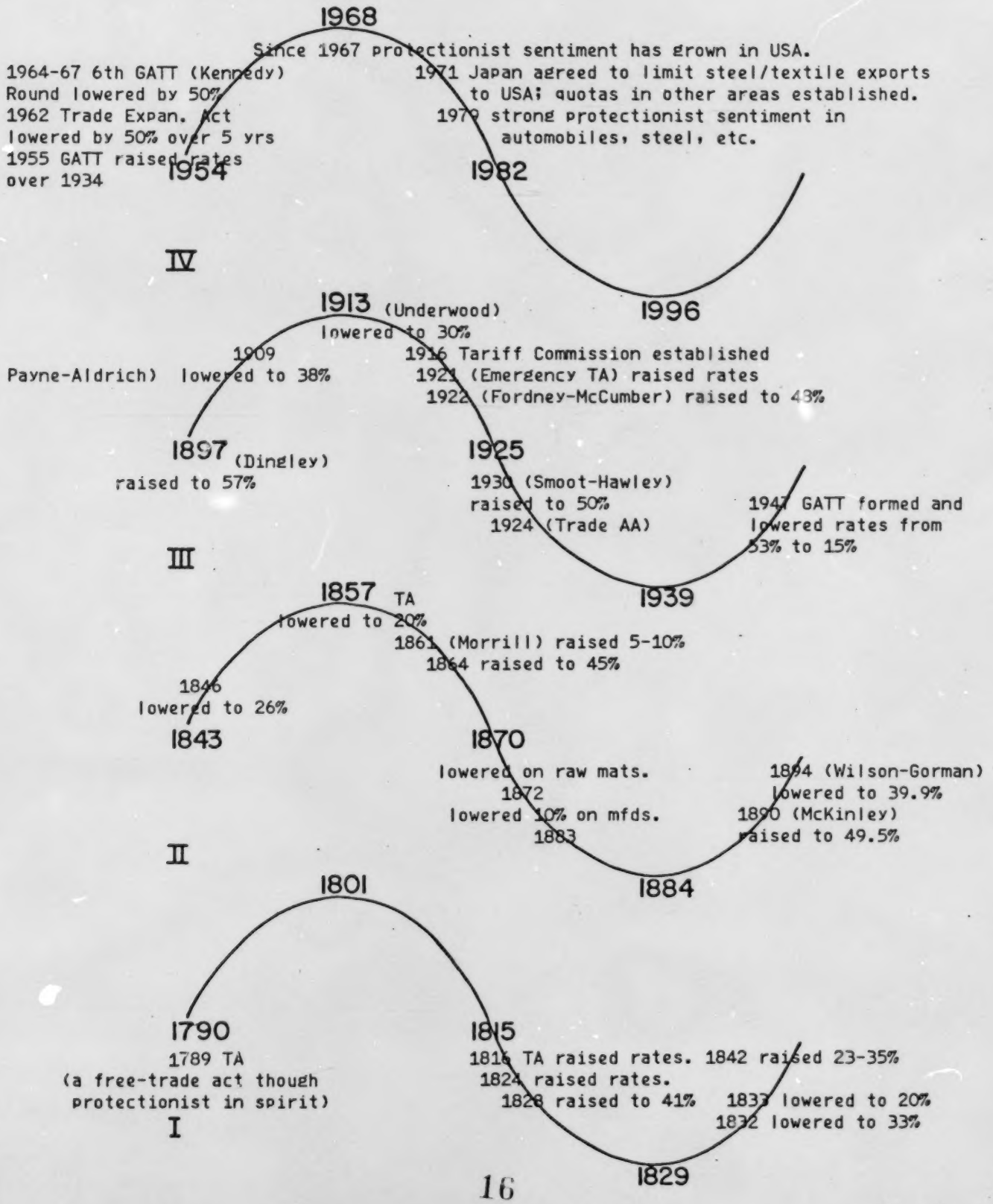


WHOLESALE COMMODITY/PRODUCERS PRICE INDEX* E

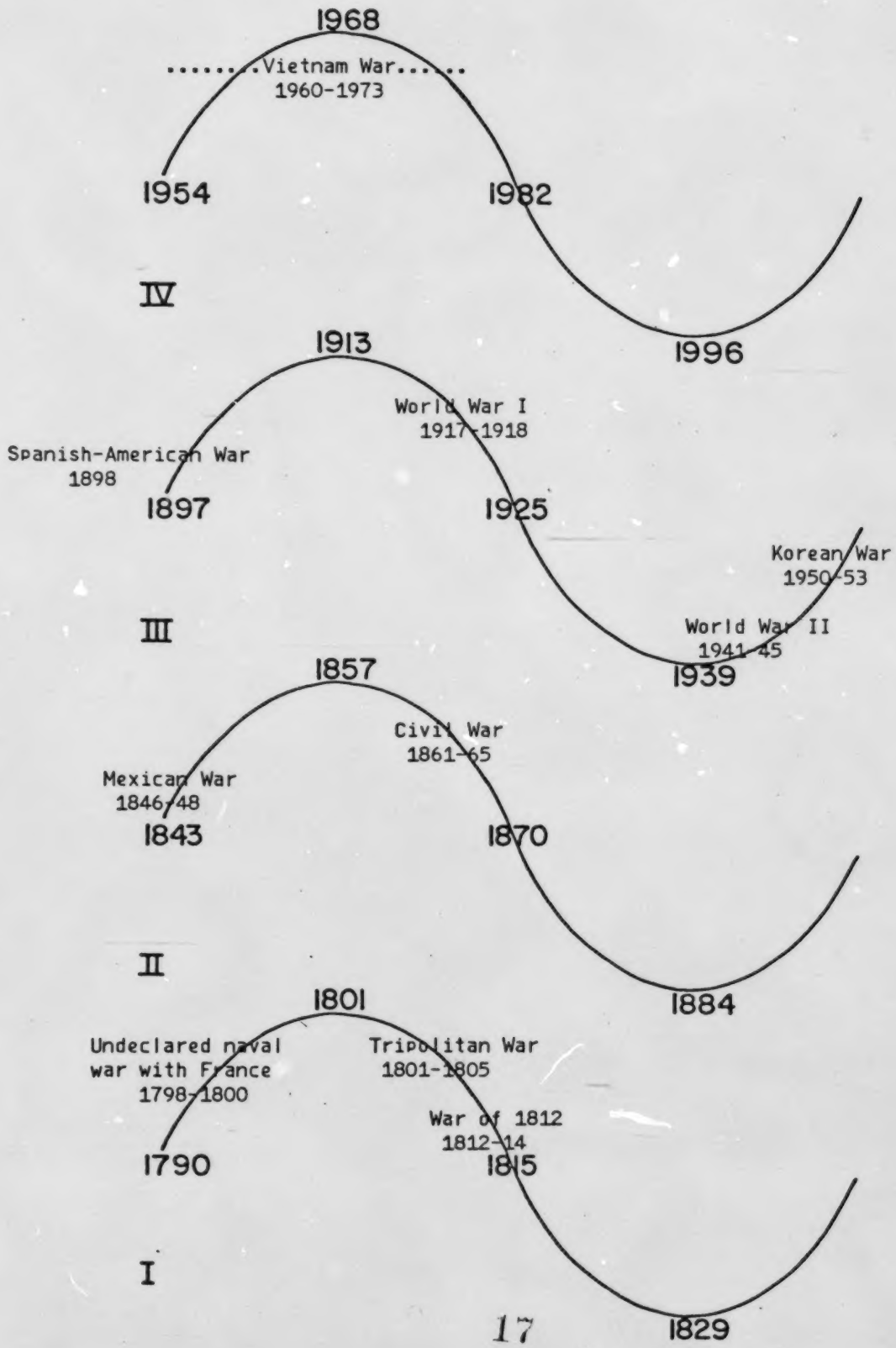



*1790-1899/100=1910-14
1890-1979/100=1967

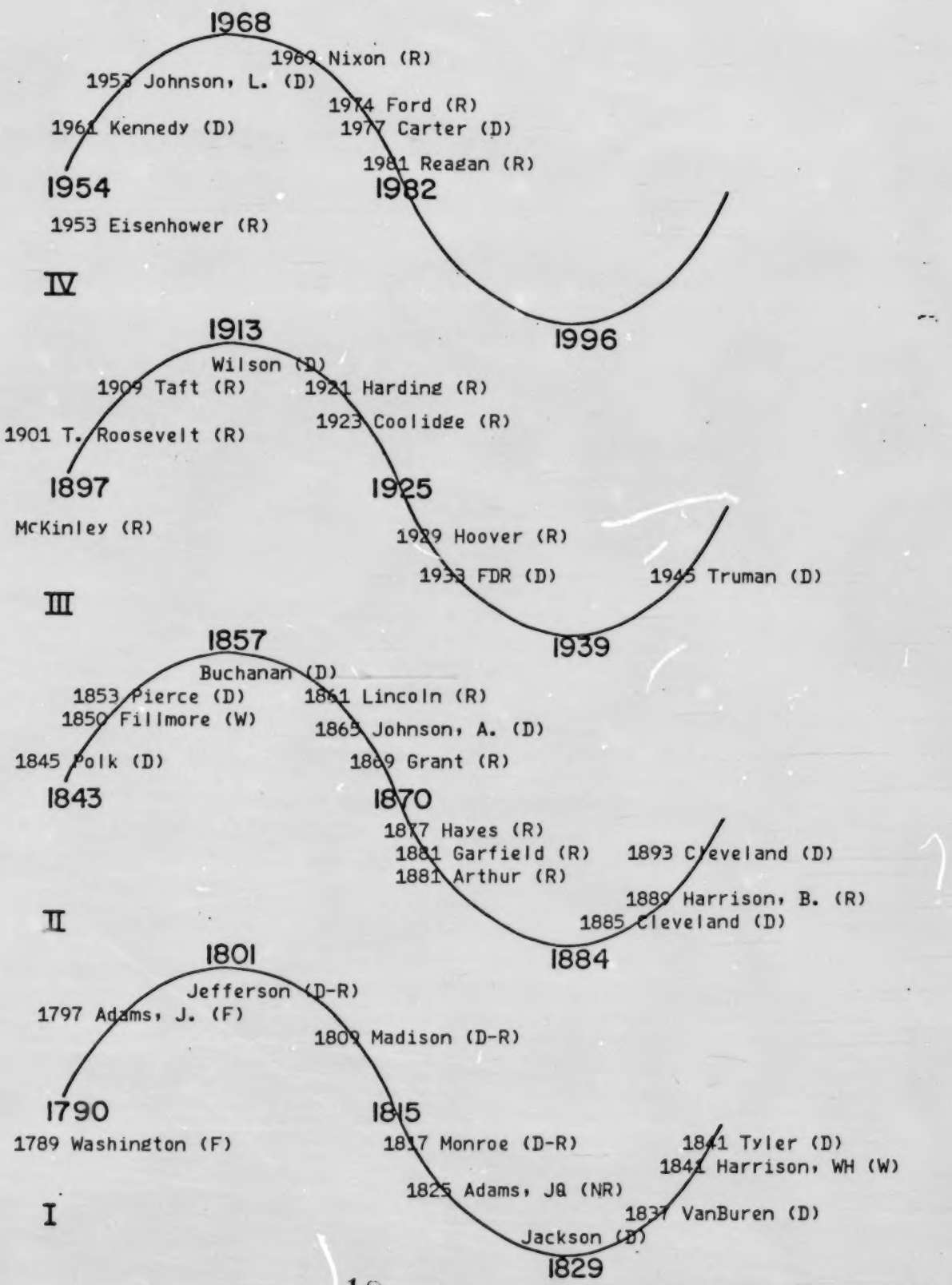
TARIFFS F


1968
Since 1967 protectionist sentiment has grown in USA.
1964-67 6th GATT (Kennedy) Round lowered by 50%
1962 Trade Expan. Act lowered by 50% over 5 yrs
1955 GATT raised rates over 1934
1954
1971 Japan agreed to limit steel/textile exports to USA; quotas in other areas established.
1979 strong protectionist sentiment in automobiles, steel, etc.
1982
IV
1913 (Underwood) lowered to 30%
1996
1909 (Payne-Aldrich) lowered to 38%
1916 Tariff Commission established
1921 (Emergency TA) raised rates
1922 (Fordney-McCumber) raised to 43%
1897 (Dingley) raised to 57%
1925
1930 (Smoot-Hawley) raised to 50%
1924 (Trade AA)
1947 GATT formed and lowered rates from 53% to 15%
III
1857 TA lowered to 20%
1939
1861 (Morrill) raised 5-10%
1864 raised to 45%
1846 lowered to 26%
1843
1870
lowered on raw mats.
1872 lowered 10% on mfds.
1883
1894 (Wilson-Gorman) lowered to 39.9%
1890 (McKinley) raised to 49.5%
II
1884
1801
1790
1789 TA (a free-trade act though protectionist in spirit)
1815
1816 TA raised rates.
1824 raised rates.
1828 raised to 41%
1842 raised 23-35%
1833 lowered to 20%
1832 lowered to 33%
I
1829

WARS G

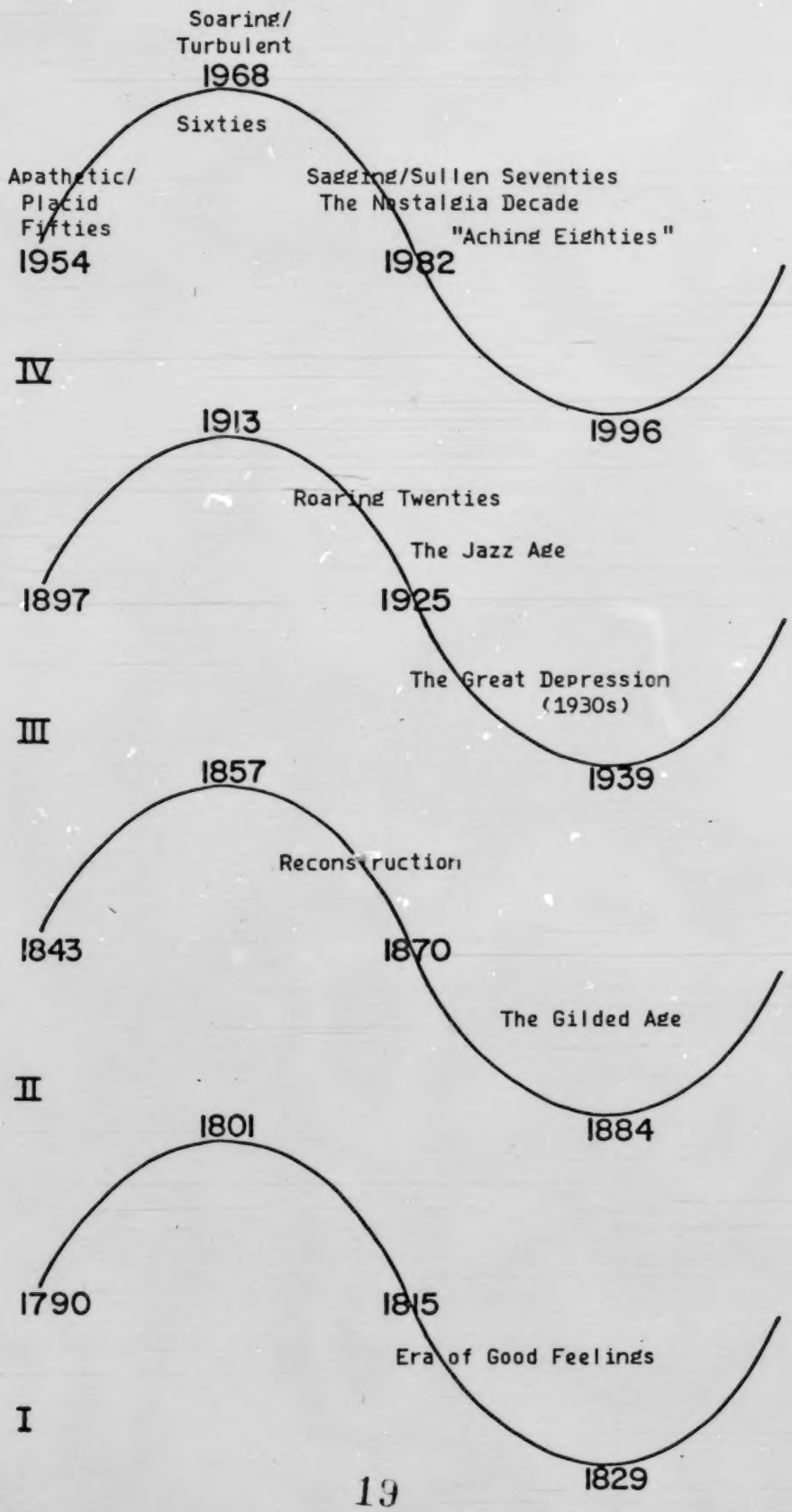

1968
.....Vietnam War.....
1960-1973
1954
1982
IV
1996
1913
World War I
1917-1918
Spanish-American War
1898
1897
1925
Korean War
1950-53
III
World War II
1941-45
1939
1857
Civil War
1861-65
Mexican War
1846-48
1843
1870
II
1884
1801
Undeclared naval
war with France
1798-1800
Tripolitan War
1801-1805
War of 1812
1812-14
1790
1815
I
1829

PRESIDENTS OF THE UNITED STATES H



NICKNAMES OF DECADES

I



IV (1954-1967) began with rising prosperity which continued except for two brief recessions in 1956-1957 and 1960-1961. This period has been called the most prosperous in American history.

RECESSIONS

I (1801-1814) entered with a wave of prosperity coming in 1803-1807 which ended with recession when the Embargo Act of 1807 was passed, followed by a recovery in 1809 and a war boom from 1812-1814.

II (1857-1869) began with a recovery and was followed by a war boom from 1858-1865.

III (1913-1925) had a war boom from 1914-1918, a sharp deflation from 1920-1921, followed by a rising tide of prosperity from 1922-1929.

IV (1968-1982) had a war boom and spiraling inflation from 1969-1973, followed by increasingly deepening recessions in 1969-1971, 1973-1975, and 1979-1980. The latter two periods have been called times of "stagflation," when both inflation and stagnation occurred simultaneously, a situation without precedent.

DEPRESSIONS

I (1815-1828) started with a downturn which was checked by European demand for U.S. farm products, followed by the collapse of foreign markets in 1819, the rapid sinking of land values, and the failure of many banks and commercial firms, with a general business depression to 1822.

II (1870-1883) began with the failure of Jay P. Cooke and Company in 1873 which brought on a crash, bankruptcies among banks and brokers, and a precipitous fall of prices, with recovery starting in 1878 and continuing to 1882, but followed by a depression from 1883-1885.

III (1925-1938) set out with prosperity, followed by the stock market crash of 1929 and a deepening depression from 1930-1933. The federal government intervention thereafter was followed by a slow recovery beginning in 1935 which was interrupted by a brief depression in 1937, after which recovery continued.

IV (1982-1995)

RECOVERIES

I (1829-1842) started in recovery which continued slowly to 1834 with brisk business activity from 1834-1836. Then came a sharp collapse in 1837, halted briefly in 1838, but followed by a major slump in 1839 which led to a protracted depression to 1843.

II (1884-1896) began with a depression which ended in 1885, followed by a recovery which lasted until 1890, a short recession in 1890-1891, an upturn in 1892, and a severe depression from 1893 to 1897, during which 15,000 commercial firms and more than 400 banks failed.

III (1939-1953) started in depression which ended with the outbreak of World War II, followed by a war boom, after which there was an inflationary upturn and general business expansion, interrupted by two recessions in 1948-1949 and 1953-1954.

IV (1996-2009)

These variations from the expected do not invalidate the Schumpeterian schema, since each phase of the cycle has its tasks to perform, appearances to the contrary. For instance, the function of the Recessions is to start the "spring cleaning" of the economic system, ridding it of obsolescence and inefficiency, and opening the way for technological and operational innovations in production units. If these tasks are not completed during the Recession, they will continue into the Depression. Thus, the first three Recessions were late in exhibiting recessionary characteristics. They got into the business of "cleaning out the Augean stables" of the economic system late in their life cycle, thereby making the following Depression necessary.

---

[1]Most of the economic information presented here was obtained from the Encyclopedia of American History: Bicentennial Edition (New York: Harper and Row, 1976).

The function of Recoveries is to enable innovations to gestate and attain commercial viability; but the process may start late due to the severity of the preceding Depression and because the "house cleaning" of the economy took longer than required, as was the case in Kondratieffs I and II; the Kondratieff III Recovery, however, developed more normally.

## Applications to Higher Education

Economic innovation is a matter of creating new firms for the production of new things, of old firms finding new ways of making things, and of turning existing productive forces to new uses. There are four steps in the innovating process: ignition, gestation, operation, and harvest. When one analyzes "academic firms" in these terms, the ignition stage does not refer simply to the chartering or founding of new colleges, but rather the beginning of instruction, i.e., the actual application of production forces. Figures J, K, and L show, by type of institution, the number and percentage of privately and publicly controlled colleges extant in 1976 which began undergraduate instruction at various points in the Kondratieff cycle since 1636.

"Ignition" of Carnegie Category 3 (Fig. J) institutions--classical liberal arts colleges--took place during the Colonial era and downgrade of Kondratieff I. The other three classes of institutions originated during the downgrade of Kondratieff II. Gestation and expansion occurred during the upswings of Kondratieffs II, III, and IV. Thus, institutionally speaking, we may

PRIVATE AND PUBLIC COLLEGES AND UNIVERSITIES BY CARNEGIE TYPE
Which Began Undergraduate Instruction 1636-1976

| Carnegie Type | CHRONOLOGICAL PERIODS: Colonial n | Colonial % | KW I n | KW I % | KW II n | KW II % | KW III n | KW III % | KW IV n | KW IV % | Totals n | Totals % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PRIVATELY-CONTROLLED INSTITUTIONS | | | | | | | | | | | | |
| 1.1, 1.2, 1.3, 1.4[1] | 7 | 11 | 10 | 15 | 36 | 55 | 13 | 20 | 0 | 0 | 66 | 100 |
| 2.1, 2.2[2] | 1 | 1 | 11 | 5 | 98 | 43 | 103 | 45 | 17 | 7 | 230 | 101 |
| 3.1, 3.2[3] | 5 | 1 | 49 | 10 | 187 | 38 | 202 | 41 | 47 | 10 | 490 | 100 |
| 4.[4] | 1 | 1 | 4 | 2 | 29 | 15 | 93 | 47 | 71 | 36 | 198 | 101 |
| Totals | 14 | - | 74 | 8 | 350 | 36 | 411 | 42 | 135 | 14 | 984 | 100 |
| PUBLICLY-CONTROLLED INSTITUTIONS | | | | | | | | | | | | |
| 1.1, 1.2, 1.3, 1.4[1] | 2 | 2 | 16 | 14 | 70 | 59 | 22 | 19 | 8 | 7 | 118 | 101 |
| 2.1, 1.1[2] | 0 | 0 | 3 | 1 | 88 | 28 | 184 | 58 | 42 | 13 | 317 | 100 |
| 3.2[3] | 1 | 14 | 0 | 0 | 2 | 29 | 2 | 29 | 2 | 29 | 7 | 101 |
| 4.[4] | 0 | 0 | 2 | - | 9 | 1 | 262 | 27 | 706 | 72 | 979 | 100 |
| Totals | 3 | - | 21 | 1 | 169 | 12 | 470 | 33 | 758 | 53 | 1421 | 99 |
| Grand Totals | 17 | 1 | 95 | 4 | 519 | 22 | 881 | 37 | 893 | 37 | 2405 | 101 |

[1] 1.1 = Research Universities; 1.2 = Research Universities II; 1.3 = Doctorate-Granting Universities I; 1.4 = Doctorate-Granting Universities II.

[2] 2.1 = Comprehensive Universities and Colleges I: 2.2 = Comprehensive Universities and Colleges II.

[3] 3.1 = Liberal Arts Colleges I; 3.2 = Liberal Arts Colleges II.

Source: A Classification of Institutions of Higher Education, Berkeley, CA: Carnegie Council on Policy Studies in Higher Education, 1976.

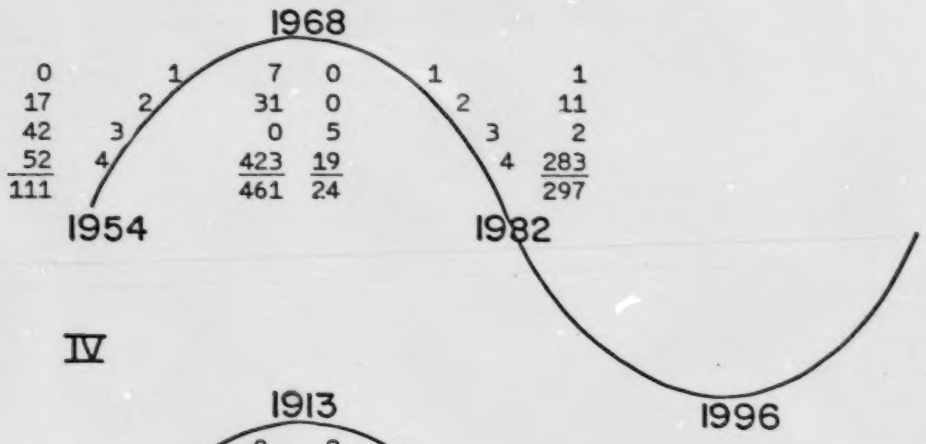
[4] 4.0 = Two-Year Colleges and Institutes.

Source: 1977 Community, Junior, and Technical College Directory, Washington, D. C.: American Association of Community and Junior Colleges, 1977.

K

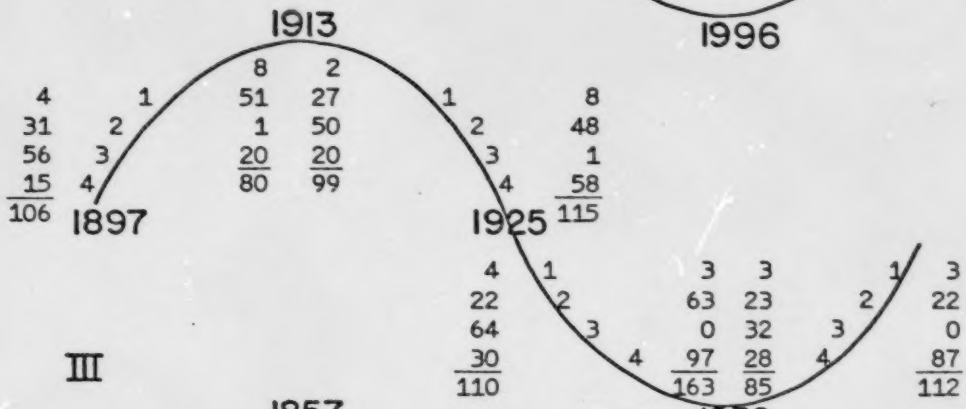
# NUMBER OF PUBLIC AND PRIVATE COLLEGES AND UNIVERSITIES
## Which Began Undergraduate Instruction 1636-1976
## By Carnegie Types 1 - 4

Left Columns = Private Colleges  Right Column = Public Colleges



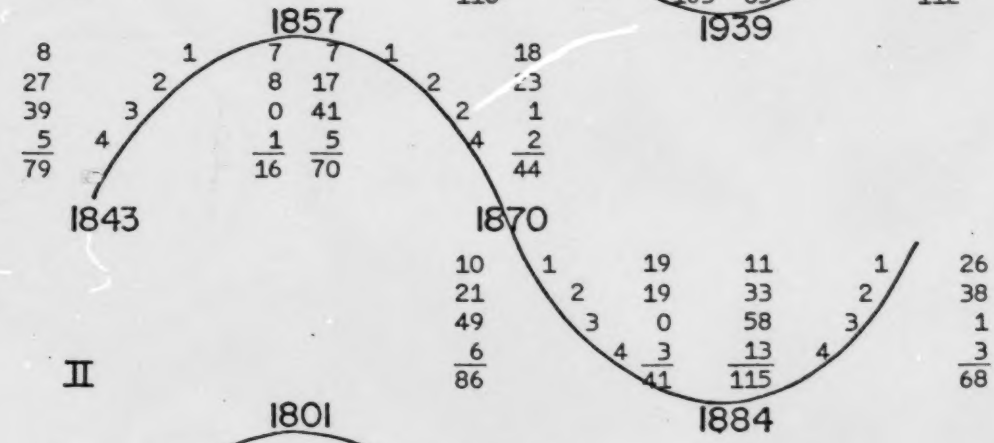

IV

| 1954 | | | 1982 | | |
|---|---|---|---|---|---|
| 0 | 1 | 7 | 0 | 1 | 1 |
| 17 | 2 | 31 | 0 | 2 | 11 |
| 42 | 3 | 0 | 5 | 3 | 2 |
| 52 | 4 | 423 | 19 | 4 | 283 |
| 111 | | 461 | 24 | | 297 |



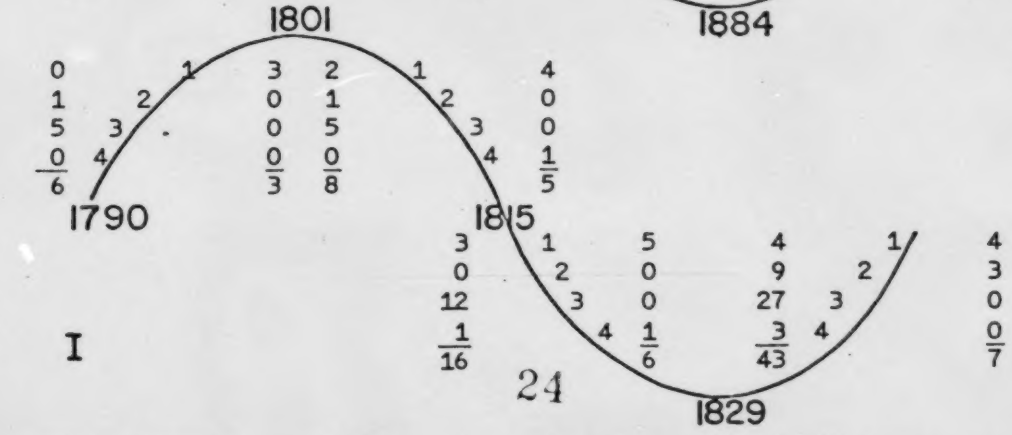

III

| 1897 | | | 1925 | | | 1939 | | |
|---|---|---|---|---|---|---|---|---|
| 4 | 1 | 8 | 2 | 4 | 1 | 3 | 3 | 1 | 3 |
| 31 | 2 | 51 | 27 | 22 | 2 | 63 | 23 | 2 | 22 |
| 56 | 3 | 1 | 50 | 64 | 3 | 0 | 32 | 3 | 0 |
| 15 | 4 | 20 | 20 | 30 | 4 | 97 | 28 | 4 | 87 |
| 106 | | 80 | 99 | 110 | | 163 | 85 | | 112 |




II

| 1843 | | | 1870 | | | 1884 | | |
|---|---|---|---|---|---|---|---|---|
| 8 | 1 | 7 | 7 | 10 | 1 | 19 | 11 | 1 | 26 |
| 27 | 2 | 8 | 17 | 21 | 2 | 19 | 33 | 2 | 38 |
| 39 | 3 | 0 | 41 | 49 | 3 | 0 | 58 | 3 | 1 |
| 5 | 4 | 1 | 5 | 6 | 4 | 3 | 13 | 4 | 3 |
| 79 | | 16 | 70 | 86 | | 41 | 115 | | 68 |



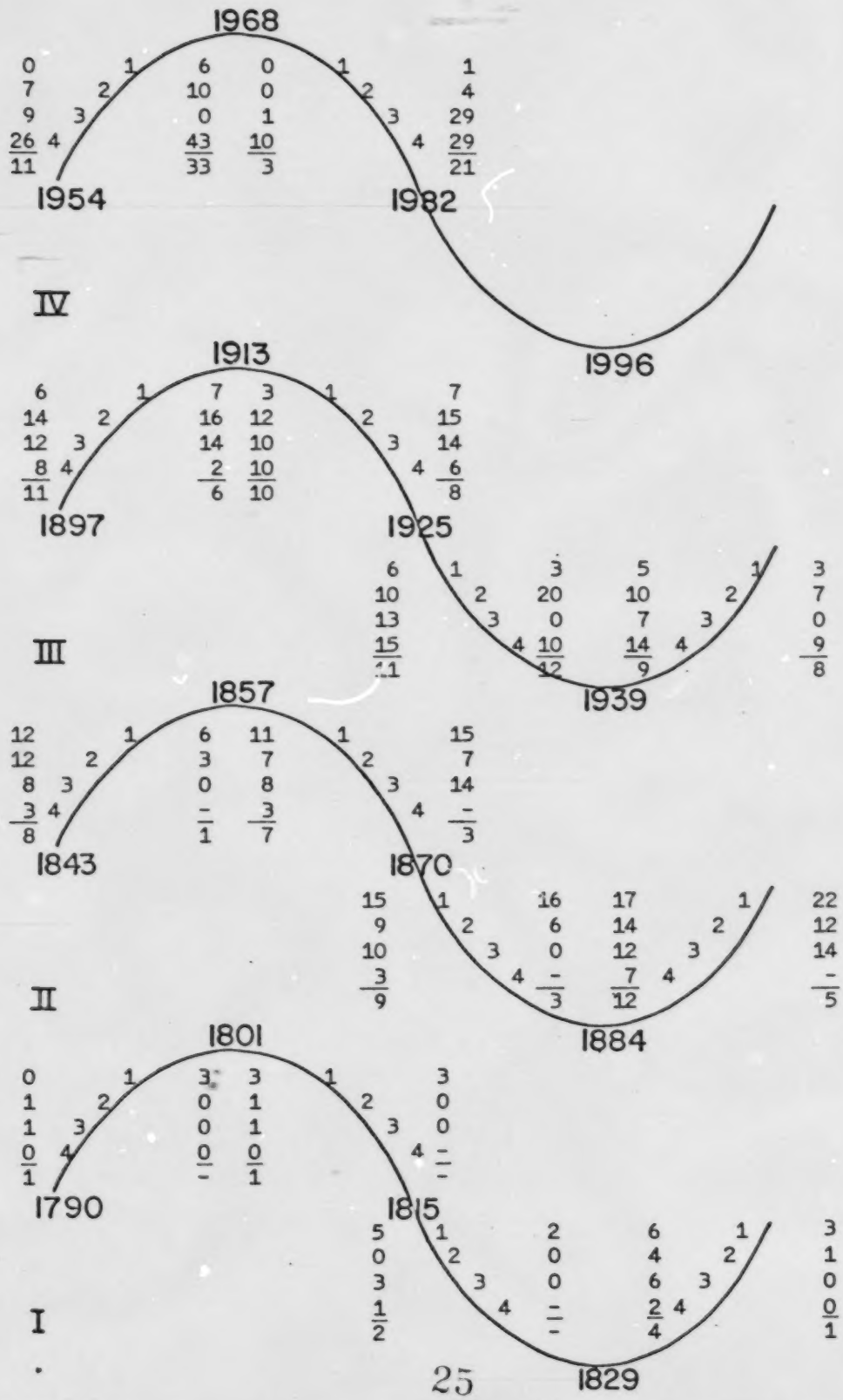

I

| 1636-1789 | | |
|---|---|---|
| 7 | 1 | 2 |
| 1 | 2 | 0 |
| 5 | 3 | 1 |
| 1 | 4 | 0 |
| 14 | | 3 |

| 1790 | | | 1815 | | | 1829 | | |
|---|---|---|---|---|---|---|---|---|
| 0 | 1 | 3 | 2 | 3 | 1 | 5 | 4 | 1 | 4 |
| 1 | 2 | 0 | 1 | 0 | 2 | 0 | 9 | 2 | 3 |
| 5 | 3 | 0 | 5 | 12 | 3 | 0 | 27 | 3 | 0 |
| 0 | 4 | 0 | 0 | 1 | 4 | 1 | 3 | 4 | 0 |
| 6 | | 3 | 8 | 16 | | 6 | 43 | | 7 |

# PERCENTAGE OF PUBLIC AND PRIVATE COLLEGES AND UNIVERSITIES
## Which Began Undergraduate Instruction 1636-1976

Left Columns = Private Colleges  Right Columns = Public Colleges




| 1636-1789 | |
|---|---|
| 11 1 | 2 |
| 1 2 | 0 |
| 1 3 | 14 |
| 1 4 | 0 |
| 2 | - |

call Kondratieff I the Classical Liberal Arts College Wave, Kondratieff II the University Wave, Kondratieff III the General Education/Liberal Arts College Wave, and Kondratieff IV the Community College Wave, reflecting the type of institution that "took off" during each wave and set its institutional tone.

It appears that the spirit of the times in each wave has deeply affected the contemporary institution-founding movements. During Kondratieff I it was competitive commercial capitalism, competitive denominationalism, and competitive provincial and community loyalties and rivalries that animated the classical liberal arts college movement. In Kondratieff II it was the spirit of competitive industrial capitalism and the drive for bourgeois progress and success which impelled the university movement. In spite of the fact that college students generally were infected with a "spirit of change, social protest, and repudiation of the past" (Rudolph, 1962, p. 468), it was the uncertainty and insecurity of the Great Depression that undergirded the longing for the stability of ageless roots in Western Civilization and motivated the General Education movement during the downgrade of Kondratieff III. Finally, it would appear that the Community College building mania of the 1960s was fuelled by the most prosperous upswing period in the history of the nation and encouraged by the forces for democratization and affirmative action in America. In like vein, Rudolph has written that "curricular history is American history and therefore carries

the burden of revealing central purpose and driving directions of American society" (Rudolph, 1977, p. 24).

Undergraduate education began as general education at Harvard in 1636, designed to provide a cultural center of gravity and a comprehensive common foundation for those who struggled with the translation of Latin and Greek and religious writings. The bases for its unity and coherence were the classics of antiquity and Christianity. It was thought of much as the academic or scientific disciplines are perceived today--as a body of knowledge with its own harmony and consistency. However, it was not meant to provide specialized training for future clergymen, lawyers, doctors, or teachers, even though most of the graduates during the seventeenth and eighteenth centuries entered one or the other of those professions. The early colleges were called literary institutions, and, later, liberal arts colleges. The term "general education" itself was not used until the 19th century to describe the offerings of these colleges; the General Education movement is a relatively recent, 20th century phenomenon. In this paper, the liberal arts, liberal education, and general education are used synonymously in terms of their goals, though not necessarily in terms of their specific content or methods of instruction.

## The Undergraduate Curriculum

The history of the undergraduate curriculum in America mirrors the ups and downs of the Kondratieff Waves. Major, or primary, innovations in curricular development and structure

of higher education have tended to ignite during Kondratieff Wave downturns, while minor or secondary changes may start during both upswings and downturns. Furthermore, since Americans become more concerned about security and stability during Recessions and Depressions, the academy reflects this concern and tends to emphasize a return to its cultural roots in the undergraduate curriculum during these periods. This may be why interest in liberal and general education has essentially been a downturn phenomenon, for the academy and society have traditionally looked to the liberal arts and humanities as the source of unity and coherence in the undergraduate curriculum.

Throughout the late 18th century and all of the 19th century, the forces for and against academic and curricular reform became competitors in the academic world and were mobilized into camps which intermittently erupted into open hostilities. The struggle continued and battles raged over many years, especially during the latter part of the 19th century. At least four congeries of competitors or combatants have been identified: Besides (1) the lovers of liberal learning and undergraduate teaching, who included the classicists and faculty-psychology mental disciplinarians, there were (2) the pure and applied scientists along with those friendly to scholarly research. (3) The utilitarians were interested in the practical value of a college education, including vocational training, and also saw the graduate as a potential reformer who would restore the political virtue of an urbanizing

nation (Veysey, 1965, p. 72). Finally, there were (4) the pious who were deeply committed to the doctrine of mental discipline as the protector of the orthodox certainties with which the educated future members of an establishment must be stamped. Rudolph vividly portrays the situation from the 1870s on:

> The friends of pure science and of scholarly research identified the enemy as undergraduate teaching and utilitarian values: the friends of liberal learning who identified the enemy as the scientists, both pure and applied; and the friends of the useful for whom the enemy was everyone else--all were very much aware that the stakes were high and that if the consequences were not of great popular interest they were of tremendously greater importance than the outcome of all the football games ever played. (Rudolph, 1977, p. 5)

The major events in the lives of two of the four clusters of academic antagonists are traced in Figures M and N. Figure M plots 81 innovations and other developments affecting the "original academic natives," the lovers of classical and liberal learning, who staunchly and stubbornly defended and protected, bolstered and strengthened, defined and redefined their beloved home territory. Figure N shows 85 innovative changes and other events in the lives of the "intruding invaders," the scientists and researchers who criticized, attacked, weakened, or otherwise threatened liberal education.

The first six liberal arts colleges (Figure M, Items 1-6; hereafter the Figure will be identified only by an upper case letter and events by their arabic numerals) may be likened to "academic firms" which produced an indispensable and prescribed classical course of study for the future leaders of an agrarian,

economic, political, and social establishment. As long as the "curriculum defined the market," the literary institutions survived as "the only game in town" (Rudolph, 1977, p. 236). However, as early as the 1730s and '40s, when the evangelical religious revival of the Great Awakening swept the colonies, it became clear that a developing America would require something more than the Puritan or Anglican ways of religion and education. These stirrings were reflected in the foundings of the new colleges beginning in the 1750s (M 8-10).

For almost 75 years the "original academic natives" maintained their curriculum. Then, little by little, new settlers with notions of science began to "sneak" into the academic establishment with a new course in mathematics here, a course in natural philosophy (physics) or astronomy there, followed perhaps by an occasional professorship or funded chair in one of the sciences, the introduction of arithmetic as an admission requirement, or such things as a scientific expedition to Newfoundland (N 1-8).

By 1766, in fact, six of the eight literary colleges had professorships of natural philosophy and mathematics (N 10). However, the forces of the traditional classical curriculum rose to the defense of their territory when in 1763 President Miles Cooper of King's College revised the course of study to keep it in line with his own Oxford alma mater (M 7) and seven new literary institutions began collegiate instruction between 1776 and 1789 (M 11). But neither such defensive measures nor

EVENTS IN THE DEVELOPMENT OF LIBERAL ARTS EDUCATION

(I = Ignition of Innovation)

M

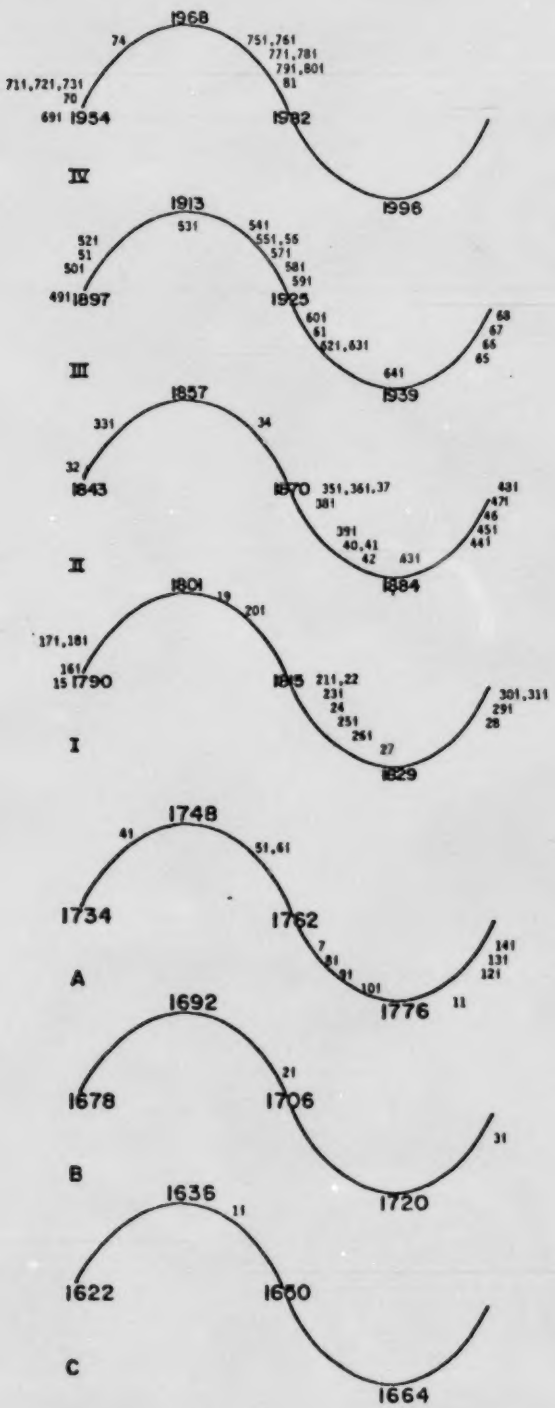


Figure M

EVENTS IN THE DEVELOPMENT OF THE LIBERAL ARTS

| No. | Year | Phase of Innovation | Item |
|---|---|---|---|
| 1. | 1637 | ignition | Harvard College (MA) (founded 1636) began collegiate instruction. |
| 2. | 1702 | ignition | The Collegiate School (CT) (founded 1701 and named Yale College in 1718) started college level instruction. |
| 3. | 1729 | ignition | The College of William and Mary (VA) (founded 1693) began collegiate instruction. |
| 4. | 1747 | ignition | The College of New Jersey (founded by Old Side Presbyterians of the Synod of Philadelphia in 1746 and called Princeton College) began collegiate instruction. |
| 5. | 1754 | ignition | King's College (NY) (Columbia College in 1784) started collegiate instruction. |
| 6. | 1754 | ignition | The Academy of Philadelphia (PA) (founded 1740; University of Pennsylvania in 1791) began collegiate instruction. |
| 7. | 1763 | expansion | King's College curriculum was revised by its president (Miles Cooper) to bring it more in line with his own Oxford alma mater's classical and traditional course of study. |
| 8. | 1765 | ignition | Rhode Island College (founded in 1764 by Baptists; Brown University in 1804) began collegiate instruction. |
| 9. | 1770 | ignition | Dartmouth College (NH) (founded in 1769 by a New Light Congregationalist minister as an outgrowth of Moor's Indian Charity School which opened about 1750) started collegiate instruction. |
| 10. | 1771 | ignition | Queen's College (NJ) (founded in 1765 by Dutch Reformed Protestants; Rutgers College in 1825) started collegiate instruction. |

| No. | Year | Phase of Innovation | Item |
|---|---|---|---|
| 11. | 1776-1789 | expansion | Seven liberal arts (literary) institutions began collegiate instruction during the Recovery phase preceding KW I Prosperity: 1776-Hampden-Sydney Academy (VA) and Liberty Hall Academy (PA) which became Washington and Lee College in 1871, 1782-Washington College (MD), 1783-Dickinson College (PA), 1785-College of Charleston (SC), 1787-Franklin College (PA) which became Franklin and Marshall College in 1853, 1789-St. John's College (MD). |
| 12. | 1779 | ignition | French was taught at King's (NY) and William and Mary (VA) colleges for the first time. |
| 13. | 1780s | ignition | Hampden-Sydney (VA) accepted French as a substitute for Greek as a graduation requirement. |
| 14. | 1787 | ignition | Harvard (MA) permitted the substitution of French for Hebrew. |
| 15. | 1790-1800 | expansion | Eight liberal arts (classical) institutions started instruction during KW I Prosperity: 1793-Williams College (MA), 1794-Blount College (TN) which became University of Tennessee in 1879 and Tusculum College (TN), 1795-Union College (NY) and University of North Carolina (Chapel Hill), 1799-Transylvania University (KY), 1800-Middlebury College (VT) and University of Vermont. |
| 16. | 1793 | ignition | Williams (MA) allowed the substitution of French for Greek in admissions until 1799; William and Mary (VA) required French for admission. |
| 17. | 1795 | ignition | Williams established the first professorship of French. |
| 18. | 1795 | ignition | Union College (NY) opened, introduced American history into the curriculum and permitted the substitution of four years of French for four years of Greek. |

| No. | Year | Phase of Innovation | Item |
|---|---|---|---|
| 19. | 1801-1814 | expansion | Eight liberal arts (general education) institutions commenced collegiate instruction during KW I Recession: 1801-University of Georgia, 1802-Jefferson College (PA) and Bowdoin College (ME), 1805-South Carolina College which became a university in 1865, 1806-Washington College (PA), 1808-Ohio University in Athens, 1812-Georgetown College (DC) which became a university in 1815, and Hamilton College (NY). |
| 20. | 1802 | ignition | Union (NY) introduced a partial-course policy which enabled students to elect courses and allowed them to substitute French for Greek. |
| 21. | 1815 | ignition | Edward Everett (1794-1865) (Harvard, 1811), professor of Greek literature at Harvard, was the first academic to undertake graduate study at Goettingen University, Germany, where he received a Ph.D. degree in 1819, the first such degree earned by an American. He was accompanied to Goettingen by George Ticknor (1791-1871) (Dartmouth 1807) who was appointed Smith professor of French and Spanish languages and literature at Harvard in 1817 while still at Goettingen. Ticknor remained in Europe two more years traveling and studying in Spain and other countries to learn their languages and literatures at first hand. Ticknor was the first American professor of modern languages. His tenure lasted until 1835. |
| 22. | 1815-1819 | expansion | Four liberal arts colleges began collegiate instruction during KW I Depression prior to the Supreme Court's ruling on the Dartmouth College Case: 1816-Allegheny College (PA), 1818-Maine Literary and Theological Institutions which became Colby College in 1899, 1819-Cincinnati College (OH) which became a university in 1870, and Western University of Pennsylvania which became University of Pittsburgh in 1908. |

| No. | Year | Phase of Innovation | Item |
|---|---|---|---|
| 23. | 1819 | ignition | The U.S. Supreme Court ruling in The Trustees of Dartmouth College v. Woodward (Per Curiam), known as the Dartmouth College Case, legally "unleashed" an era of sectarian liberal arts college foundings by both old and new denominations (Rudolph, 1962, p. 211). |
| 24. | 1820-1828 | expansion | Twelve liberal arts institutions began collegiate instruction during KW I Depression following the Dartmouth College Case ruling: 1820-Centre College of Kentucky and St. Louis College (MO) which became a university in 1832, 1821-Amherst College (MA), 1822-Columbia College (DC) which became George Washington University in 1904 and Geneva College (NY) which became Hobard College in 1860, 1824-Kenyon College (OH), Miami University (OH), and Washington College (CT) which became Trinity College in 1845, 1825-College of Louisiana which became Centenary College of Louisiana in 1845 and University of Virginia, 1826-Western Reserve College (OH) which became a university in 1884, 1828-Indiana College (Bloomington, IN) which became a university in 1838. |
| 25. | 1825 | ignition | Yale brought French into its curriculum as a non-credit option. |
| 26. | 1827 | ignition | Yale corporation appointed a committee "to inquire into the expediency of so altering the regular course of instruction in this college, as to leave out of said course the study of the dead languages, substituting other studies therefor; and either requiring a competent knowledge of said languages, as a condition of admittance into the college, or providing instruction in the same, for such as shall choose to study them after admittance." |

| No. | Year | Phase of Innovation | Item |
|---|---|---|---|
| 27. | 1828 | defense of the "old" | Yale issued its Reports on the Course of Instruction in Yale College; by a Committee of the Corporation, and the Academical Faculty which "put the weight of a great American college behind things as they were" (Rudolph, 1962, p. 131). |
| 28. | 1837 | | Ralph Waldo Emerson delivered his famous address, The American Scholar, at Harvard, criticizing the prescribed course of study which had come from abroad and urging that an American culture and an individualized curriculum be developed. |
| 29. | 1839 | ignition | Anglo-Saxon was introduced as a non-credit option. |
| 30. | 1841 | ignition | German entered the curriculum as an option. |
| 31. | 1841 | ignition | Yale's catalogue permitted modern languages to be taught at the student's own expense and as a substitute for Plato or calculus. |
| 32. | 1846 | defense of the "old" | Edward Everett, former U.S. Minister to Great Britain, President of Harvard, 1846-1849, polled the faculty and found them about equally divided in their views on the elective system. Accordingly, Harvard reduced the number of electives to three each in both the junior and senior years. The rest of the curriculum was completely prescribed and consisted mostly of classical and liberal arts. |
| 33. | 1847 | ignition | Ancient history was added to admission requirements. |
| 34. | 1867 | | Harvard made Latin and Greek optional for juniors. |

| No. | Year | Phase of Innovation | Item |
|---|---|---|---|
| 35. | 1870s | ignition | Admission to college by high school certificate was initiated. By 1897 the practice had been adopted by 200 institutions. |
| 36. | 1870s | ignition | Six more subjects were added to college admission requirements. By 1897, 80 colleges had followed the practice and 30 colleges required neither Latin nor Greek for admission. |
| 37. | 1870s & 1880s | | The "Battle of the Electives" was being waged. |
| 38. | 1872 | ignition | Harvard abolished all subject requirements for seniors. |
| 39. | 1879 | ignition | Harvard abolished all subject requirements for juniors. |
| 40. | 1880s & 1890s | | Colleges abandoned their preparatory departments. |
| 41. | 1880s & 1890s | | The "Battle over the Classics" raged. |
| 42. | 1883 | ignition | Harvard extended electives to cover three-fifths of freshman work. |
| 43. | 1884 | ignition | Harvard abolished all subject requirements for sophomores. |
| 44. | 1890s | ignition | Innovations in defense of the "old" were made in order to place controls on the elective system and "to discipline freedom": concentration, distribution, and grouping of courses, honors programs, majors, minors, survey courses, sequences of courses, graded courses, tutorials, preceptorials, independent study, field studies, reading periods, seminars, and comprehensive examinations. Over the years these controls were refined and became more and more sophisticated. |

| No. | Year | Phase of Innovation | Item |
|---|---|---|---|
| 45. | 1892 | ignition | The National Education Association's Committee of Ten, with Harvard's President Eliot in the chair, standardized the high school curriculum essentially as a college-preparatory liberal arts course. |
| 46. | 1893-1906 | defense of the "old" | The private liberal arts college-preparatory schools' revival strengthened many of the older schools and founded many new ones. |
| 47. | 1895 | ignition | Harvard required only two English and one modern language course for graduation. |
| 48. | 1896-1913 | ignition | Several national associations were established to redefine the liberal arts college and to set its standards, e.g., American Association of Universities, General Education Board, Carnegie Foundation for the Advancement of Teaching, the Rockefeller Foundation, et al. Much of this activity occurred during KW III Recession. |
| 49. | 1897 | ignition | Harvard abolished all subject requirements for freshmen except English composition. |
| 50. | 1900 | ignition | The College Entrance Examination Board (CEEB) standardized entrance examinations for colleges and led to curricular stability along liberal education lines. By 1908 25 leading Eastern institutions used them. |
| 51. | 1910 | defense of the "old" | Harvard's new president, Abbott Lawrence Lowell (Harvard 1877), called for an honors college and developed a plan for concentrations in fields of study. During his 24-year tenure, most of which occurred in the KW III downswing, he introduced the tutorial system and the house plan. |

| No. | Year | Phase of Innovation | Item |
|---|---|---|---|
| 52. | 1911 | ignition | Reed College (OR) opened and initiated the general orientation course for freshmen. By 1926, 100 colleges and universities had orientation programs for freshmen. |
| 53. | 1913 | ignition | Harvard required general comprehensive examinations for seniors in history, government, and economics with the hope of bringing coherence, design, symmetry, and unity to the undergraduate curriculum. |
| 54. | 1919 | ignition | The General Education Movement of modern times was born at Columbia University when the contemporary Western Civilization course was inaugurated. It spawned a number of two-year general education and contemporary civilization courses in colleges across the country. |
| 55. | 1920 | ignition | Columbia University's general honors course gave rise to the Great-Books idea by requiring one clasic to be read per week. |
| 56. | 1920s | defense of the "old" | Harvard philosopher Irving Babbit and the New Humanists attacked colleges catering primarily to the practical and professional. They called for a prescribed liberal education. |
| 57. | 1920s & 1930s | ignition | Forty or so new and old colleges adopted and adapted General Education programs, some of which were highly successful and distinctive. |
| 58. | 1921 | ignition | Reed College (OR) initiated a two-year General Education program. |
| 59. | 1922 | ignition | Swarthmore College (PA) started its Honors Program with a $4,000,000 grant from the General Education Board. By 1930 there were 93 such programs in the United States. |

| No. | Year | Phase of Innovation | Item |
|---|---|---|---|
| 60. | 1930s & 1940s | ignition | Interdisciplinary and interdepartmental approaches to General Education proliferated--e.g., American Studies, American Civilization, American Culture--which brought together such disciplines as history, political science, literature, sociology, and art history. |
| 61. | 1936 | defense of the "old" | University of Chicago's new president Robert Maynard Hutchins' Yale lectures attacked vocationalism, empiricism, and "anti-intellectualism masquerading as experience, adjustment and preparation for life." He proposed a return to the prescribed classical curriculum. |
| 62. | 1937 | ignition | The University of Chicago's College adopted a four-year undergraduate General Education program organized into comprehensive fields of study with an autonomous faculty and comprehensive examinations at the end of year-long courses. Intercollegiate athletics and the extracurriculum were de-emphasized. |
| 63. | 1937 | ignition | St. John's College (MD) inaugurated a four-year Great Books curriculum. |
| 64. | 1939 | ignition | Harvard's Student Council Committee on Education recommended a sharp turn away from the prevailing elective system. |
| 65. | 1945 | defense of the "old" | Harvard's "Red Book" report on General Education in a Free Society called for a unifying purpose and ideas resting on common beliefs as the basis for a revitalized General Education program. Its recommendations did not materialize but a half-dozen or so options were created in each of four subject matter areas. |

| No. | Year | Phase of Innovation | Item |
|---|---|---|---|
| 66. | 1946 | defense of the "old" | Columbia University's Carman Committee proposed extending the General Education program to four years. The proposal was not adopted. |
| 67. | 1947 | redefinition | U.S. President Truman's Commission on Higher Education issued a six-volume report, Higher Education for Democracy, stating that "the crucial task of higher education today . . . is to provide for a unified general education for American youth." It also called for modifying the almost exclusively Western orientation of the curriculum. |
| 68. | 1950s | expansion | Area studies programs proliferated; history departments added non-western courses to their major requirements. |
| 69. | 1954 | ignition | Columbia College introduced the major system, thus restricting the General Education program and introducing specialization. |
| 70. | 1955 | | Howard Mumford Jones attacked general education in an Atlantic Monthly article. |
| 71. | 1960s | ignition | The quarter scheduling system was initiated and expanded, requiring reorganization of the curriculum and courses. |
| 72. | 1960s | ignition | Black Studies, Afro-American Studies, and Women's Studies came into being and proliferated. |
| 73. | 1960s & 1970s | ignition | A number of the great universities initiated innovative and distinctive general education sub-colleges. |
| 74. | 1966 | defense of the "old" | Columbia University sociologist Daniel Bell in The Reforming of General Education called for the humanities and history to reduce the intellectual provincialism bred by specialization. His recommendations were not adopted. |

| No. | Year | Phase of Innovation | Item |
|---|---|---|---|
| 75. | 1971 | ignition | Harvard made it possible to substitute two departmental courses for each general education course. |
| 76. | 1971 | ignition | Amherst dropped all general education requirements. |
| 77. | 1973 | redefinition | Harvard's Student Council Committee on Undergraduate Education (CUE) was established to reform the general education program. |
| 78. | 1973 | ignition | Levine and Weingart's Reform of Undergraduate Education reported on 26 old and new experimental colleges designed to arrest the decline in general education. |
| 79. | 1970s & 1980s | ignition | The Chronicle of Higher Education and Change magazine regularly reported on a multitude of events which indicated that many if not most of the colleges and universities in the United States were seeking to revise, reform, and redefine their undergraduate general education programs. |
| 80. | 1970s & 1980 | ignition | The Public Broadcasting Service and the British Broadcasting Corporation collaborated on producing television programs and series popularizing the general education and socialization of middle and upper-middle class members of British society: Upstairs-Downstairs, Poldark, The Duchess of Duke Street, Once Upon a Classic, and Shakespeare plays. Other general education series produced during this period included The Ascent of Man and Civilization, among others. |
| 81. | 1979 | defense of the "old" | Harvard's Task Force on a Core Curriculum reported the need for a basic core general education curriculum, better known as the "Rosowsky Report." |

EVENTS IN THE GROWTH OF SCIENTIFIC AND TECHNICAL CURRICULA

(1-Ignition of Innovation)

N

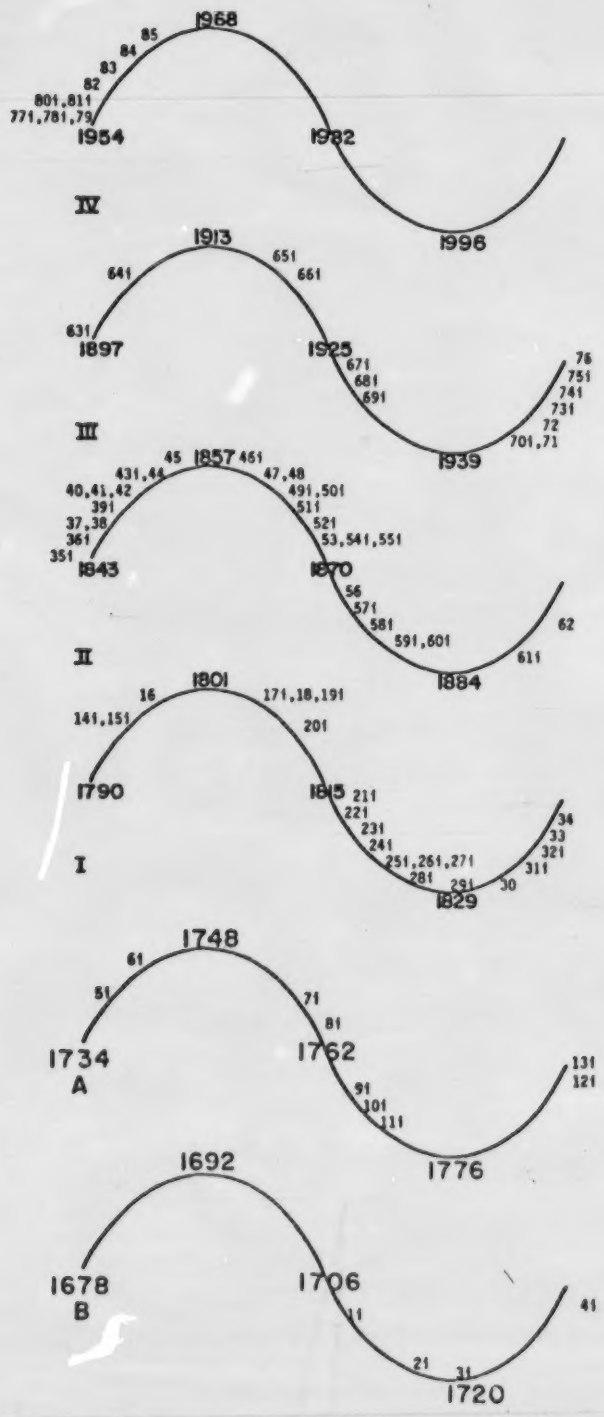


Figure N

EVENTS IN THE GROWTH OF SCIENTIFIC

| No. | Year | Phase Innovation | Item |
|---|---|---|---|
| 1. | 1711 | ignition | William and Mary C. established first professorship of natural philosophy (physics) and mathematics. |
| 2. | 1718 | ignition | Yale first offered algebra. |
| 3. | 1720 | ignition | Yale first offered astronomy in mathematical terms. |
| 4. | 1728 | ignition | Harvard established chair of natural philosophy and mathematics. During the early 18th century mathematics was taught in the senior year and comprised a little arithmetic, plane and spherical geometry. |
| 5. | 1742 | ignition | Mathematics was taught in the freshman year at Yale. |
| 6. | 1745 | ignition | Yale made arithmetic an entrance requirement, geometry was a sophomore subject, and mathematics was included in the junior year. |
| 7. | 1756 | ignition | College of Philadelphia (later University of Pennsylvania) opened with more science and mathematics in the curriculum than the other five colleges in existence. |
| 8. | 1761 | ignition | The General Court of Massachusetts financially supported an astronomical expedition to Newfoundland to observe the transit of Venus and to prove that earthquakes were natural phenomena. |
| 9. | 1765 | ignition | College of Philadelphia establishes first chair of medicine. King's College's (later Columbia University) medical college was founded in 1767, Harvard's in 1783, and Dartmouth's in 1797. |
| 10. | 1766 | expansion | Six of the eight colleges extant had professorships of natural philosophy and mathematics; by 1788 the two remaining colonial colleges had found the financial support to do likewise. |

| No. | Year | Phase of Innovation | Item |
|---|---|---|---|
| 11. | 1770 | ignition | Yale establishes a chair of natural philosophy and mathematics. |
| 12. | 1788 | ignition | College of New Jersey (later Princeton University) brought into its curriculum anatomy, botany, chemistry, and physiology. These courses first appeared in medical curricula at colleges which offered a bachelor's degree (see Item 9 above). |
| 13. | 1789 | ignition | Pennsylvania established first chair of botany and natural history. |
| 14. | 1796 | ignition | College of New Jersey had the first professor of chemistry in an arts college without a medical program. |
| 15. | 1796 | ignition | College of New Jersey admitted "scientific students" and awarded them certificates instead of bachelors' degrees. (The experiment was dropped in 1806 for lack of students.) |
| 16. | 1800 | expansion | Almost every college (there were at least 27) "boasted" of having one science professor. |
| 17. | 1802 | ignition | The U.S. Military Academy was founded, establishing the first college of applied science and the first to offer formal instruction in engineering, advanced mathematics, and drawing. |
| 18. | 1802 | expansion | Yale's appointment of the young Benjamin Silliman as Professor of chemistry, geology, and mineralogy "revolutionized American outlook on science" (Rudolph, 1977, p. 61). Yale also required seniors to take chemistry. |
| 19. | 1802 | ignition | Union College inaugurated the partial course nondegree program which permitted students to study what they wished, usually more useful contemporary courses. |
| 20. | 1807 | ignition | Union College (NY) required chemistry for seniors. |

| No. | Year | Phase of Innovation | Item |
|---|---|---|---|
| 21. | 1815 | ignition | Parallel to the classical curriculum, Union College introduced a scientific course of study offering a four-year program in which the senior year was devoted to science. |
| 22. | 1816 | ignition | Pennsylvania established a four-man faculty of physical sciences and rural economy (botany, natural history, geology, zoology, mineralogy, comparative anatomy, veterinary science). Lack of demand abolished it in 1828. |
| 23. | 1817 | ignition | The first undergraduate mineralogical society was founded at Williams College (MA). |
| 24. | 1818 | ignition | Silliman founded The American Journal of Science and Art. |
| 25. | 1819 | ignition | The American Literary, Scientific, and Military Academy was founded in Vermont. In 1834 it became Norwich University. |
| 26. | 1824 | ignition | Rensselaer School, NY (later Rensselaer Polytechnic Institute) was founded. Although it was a noncollegiate institution, it was "the center of applied science in the United States until higher education was ready to accommodate the kind of instruction and research that went on there" (Rudolph, 1977, p. 62). It became a collegiate institution in the 1850s. |
| 27. | 1826 | ignition | The first lyceum for the "advancement of learning" was organized in Millbury, MA. The lyceum movement popularized the sciences with speakers such as Benjamin Silliman. By 1828 there were 100 other branches and 3,000 by 1834. |
| 28. | 1828 | ignition | Hampden-Sydney College (VA) introduced a parallel Literary-Scientific course of study. |

| No. | Year | Phase of Innovation | Item |
|---|---|---|---|
| 29. | 1829 | ignition | USMA cadets organized the American Association for the Promotion of Science, Literature, and the Arts, "a direct forerunner of the American Association for the Advancement of Science" which was founded in 1848. |
| 30. | 1830 | expansion | Most "respectable" college faculties had two professors of science. There were at least 71 colleges in existence. |
| 31. | 1835 | ignition | Union College added civil engineering to its parallel course offerings. |
| 32. | 1836 | ignition | The University of the City of New York (later NYU) opened with a parallel English-scientific course of study. It was abandoned after the financial crash of 1837. |
| 33. | 1839 | expansion | Harvard's President Quincy agreed in principle to a parallel course system that would substitute science, history, and modern languages for Greek and Latin in the freshman year. |
| 34. | 1841 | expansion | Harvard officially sanctioned the parallel course system. |
| 35. | 1844 | ignition | Geometry was added to admission requirements. |
| 36. | 1845 | ignition | Benjamin Silliman, Jr., assistant to his father at Yale, gave the first course of lectures on agricultural chemistry at New Orleans. |
| 37. | 1847 | expansion | Harvard founded the Lawrence Scientific School (with the help of Abbott Lawrence's $50,000 gift) which started with the non-degree program. In 1851 its graduates received a bachelor of science degree. |
| 38. | 1847 | expansion | Yale developed a School of Applied Chemistry which added civil engineering in 1852 and awarded its graduates a bachelor of philosophy degree. It became the Yale Scientific School in 1854 and the Sheffield Scientific School in 1860 (with the aid of a $100,000 gift of Joseph Sheffield). |

| No. | Year | Phase of Innovation | Item |
|---|---|---|---|
| 39. | 1848 | ignition | The American Association for the Advancement of Science was founded. |
| 40. | 1850 | expansion | Brown University (RI) adopted a non-degree partial course and increased the number of its science courses, awarding a bachelor of philosophy degree for non-classical study. Lack of sufficient funding and student enrollment ended the program in 1861. |
| 41. | 1850 | expansion | The University of Rochester was founded, offering a choice of BA and BS degrees from the beginning. |
| 42. | 1850s | expansion | Denison (OH), Illinois College, NYU, North Carolina, and Wesleyan (CT) offered a course without classics leading to a BS degree. |
| 43. | 1855 | ignition | Michigan State University was established as the first agricultural college. |
| 44. | 1855 | expansion | Brown, Dartmouth, and Michigan incorporated engineering into their undergraduate curriculum by 1855. |
| 45. | 1856 | expansion | Union College added applied chemistry to its parallel courses of study. |
| 46. | 1858 | ignition | The first degree awarded by the State University of Iowa (Iowa City) was a bachelor of science. |
| 47. | 1860 | expansion | The norm for "respectable" science staffing was four professors. There were at least 380 colleges. |
| 48. | 1860s | expansion | Twenty-five institutions adopted the three-year parallel scientific programs. |
| 49. | 1862 | ignition | Congress passed the Morrill Land-Grant Act which supported at least one college in each state to provide instruction in agriculture, mechanical arts, and military service. |

| No. | Year | Phase of Innovation | Item |
|---|---|---|---|
| 50. | 1862 | ignition | Authorization by Congress of the U.S. Department of Agriculture marked the beginning of organized agricultural research. |
| 51. | 1863 | ignition | The National Academy of Sciences was chartered to foster and support research in governmental departments. |
| 52. | 1865 | ignition and expansion | Lehigh University (PA) was founded as a separate private scientific and technical institution funded by a gift from Asa Packer; this example was followed by a "wave" of foundings of similar separate private institutions with gifts from private donors: Stevens Institute of Technology (NJ) in 1870, Rose Polytechnic Institute (IN) in 1875, Case (OH) in 1881, Pratt (NY) in 1887, Drexel (PA) and Armour (IL) in 1892, and Carnegie Institute of Technology (PA) in 1905. |
| 53. | 1866 | expansion | Lafayette College (PA), a "dying" classical college with an enrollment of 115 in 1865, was revived by a $100,000 gift of Ario Pardee. Having developed a parallel scientific course leading to a BS degree, its 1872 freshman class was surpassed in size only by Cornell, Harvard, and Yale. |
| 54. | 1868 | ignition | Cornell University, founded on the basis of the Morrill Act, opened with science and manual labor experience as integral parts of its curriculum. It became the model for and the flagship of the land-grant college movement. |
| 55. | 1869 | ignition | The inaugural address of Charles William Eliot at Harvard called for collegiate reform via the elective principle through the instrument of the elective curriculum. It was the opening gun of a successful war which lasted for three decades, ending with the ultimate defeat of the prescribed, classical, liberal, and general unified curriculum--a war |

| No. | Year | Phase of Innovation | Item |
|---|---|---|---|
| | | | considered by Rudolph to be "one of the most creative, and also one of the most destructive, educational developments of the post-Civil War years" (Rudolph, 1962, p. 290). |
| 56. | 1873 | expansion | Princeton introduced a three-year scientific course, followed in 1874 by the establishment of the Green School of Science, thanks to the generosity of John C. Green. |
| 57. | 1874 | ignition | The first "chautauqua" assembly was held at Fair Point (NY), originally for the study of the Bible and Sunday school methods of teaching; gradually it embraced all fields of education with chautauqua circuit lecturers crisscrossing the country and popularizing scientific advances, among other activities. |
| 58. | 1876 | ignition | Johns Hopkins University (MD) opened as a graduate university modelled after the German research university with laboratories and seminars as modes of instruction, followed by Clark University (MA) in 1889. |
| 59. | 1880s | ignition | Scientific and professional societies were being established. |
| 60. | 1881 | ignition | Cornell offered the first course in electrical engineering. |
| 61. | 1887 | ignition | Congress passed the Hatch Act which established and supported agricultural experiment stations in land-grant colleges. |
| 62. | 1890 | expansion | The second Morrill Act was passed by Congress, providing land-grant institutions with $25,000 annual cash support. |
| 63. | 1898 | ignition | Cornell created the first professional forestry school. |

| No. | Year | Phase of Innovation | Item |
|---|---|---|---|
| 64. | 1905 | ignition | The inaugural address of Nicholas Murray Butler defined the function of Columbia University as that of training for professional work. |
| 65. | 1914 | ignition | Congress passed the Smith-Lever Act supporting the establishment of agricultural and home economics extension services in land-grant colleges, which taught useful applications of basic and applied sciences to farmers and their wives. |
| 66. | 1917 | ignition | The National Research Council was established. |
| 67. | 1930s | ignition | Through the WPA (Works Progress Administration) and the PWA (Public Works Administration), the U.S. government funded extensive university building programs. By 1939, these were worth $200 million. |
| 68. | 1933 | ignition | The Science Advisory Board (later the Science Advisory Council) was established to create a "Recovery Program of Science Progress." |
| 69. | 1937 | ignition | Establishment of the National Cancer Institute marked the beginning of organized medical research and of the National Institutes of Health. |
| 70. | 1940 | ignition | National Defense Research Committee was established. |
| 71. | 1940 | expansion | American Association for the Advancement of Science reported a membership of 21,000, its largest roster since its founding in 1848. |
| 72. | 1940 | expansion | The number of industrial laboratories and research agencies expanded from about 300 in 1920 to more than 2200 in 1940. |
| 73. | 1941 | ignition | The U.S. Office of Scientific Research and Development was created. |

| No. | Year | Phase of Innovation | Item |
|---|---|---|---|
| 74. | 1946 | ignition | The U.S. Atomic Energy Commission was established to direct research and development of uses of atomic energy. |
| 75. | 1950 | ignition | The National Science Foundation was founded. |
| 76. | 1952 | expansion | The total cost of research undertaken by industries was $2.5 billion of which $1.4 billion was paid for by the federal government. |
| 77. | 1957 | ignition | Sputnik was launched by the USSR. |
| 78. | 1957 | ignition | The Office of Special Assistant to the President for Science and Technology was created with J. R. Killian, former head of MIT, as the first incumbent. |
| 79. | 1957 | expansion | From 1951 to 1957 the Ford Foundation spent almost a billion dollars of which more than half went for the social sciences and education. The social sciences were getting a high proportion of their funds from private sources. |
| 80. | 1958 | ignition | The National Defense Education Act was passed leading to a marked increase in federal expenditures for research and education, a major part of which came from sources linked to the military establishment. |
| 81. | 1958 | ignition | National Aeronautics and Space Administration (NASA) was established to plan, develop, and conduct the country's space exploration. |
| 82. | 1960 | expansion | In 1930 the total expenditure for organized research for the entire academic system did not exceed $18 million. In 1940 it was $27.3 million; in 1950, $225.3 million; in 1960 it was more than one billion dollars. Federal subsidies were $1.5 billion for research, scholarships, and for the institutions themselves. By 1972 federal funds represented 75% of the research expenditures of all universities and 15% of their total budgets. |

| No. | Year | Phase of Innovation | Item |
|---|---|---|---|
| 83. | 1962 | expansion | Federal funds accounted for 50% of the total expenditures of MIT, Stanford, Princeton, California Institute of Technology, and University of California at San Diego. In addition, autonomous research organizations had developed connections with university scientists and their institutions, e.g., Argonne National Laboratory with Chicago, Jet Propulsion Laboratory with California Tech., Lincoln Laboratory with MIT, and the Livermore, Lawrence, and Los Alamos Laboratories with University of California. |
| 84. | 1963 | ignition | The Higher Education Facilities Act made available $1.2 billion over a three-year period. |
| 85. | 1967 | expansion | From 1947 to 1967 research funds to medical schools increased to the extent that they represented more than half of the total increase in the schools' expenditures. Federal government funds represented 85% of this total. Natural and medical research is largely financed by the federal government. |

the expansion in the number of liberal arts "academic firms" succeeded in stemming the tide. Even before the birth of the nation, demands for curricular reform were felt by the colleges when, in 1779, Thomas Jefferson, as governor of Virginia and member of the College of William and Mary's board of governors, tried to add practical and professional courses and to limit the influence of religion on the curriculum, when French was taught at William and Mary and King's for the first time (M 12), when Hampden-Sydney accepted French as a substitute for Greek as a requirement for graduation (M 13), and when Harvard permitted the substitution of French for Hebrew (M 14).

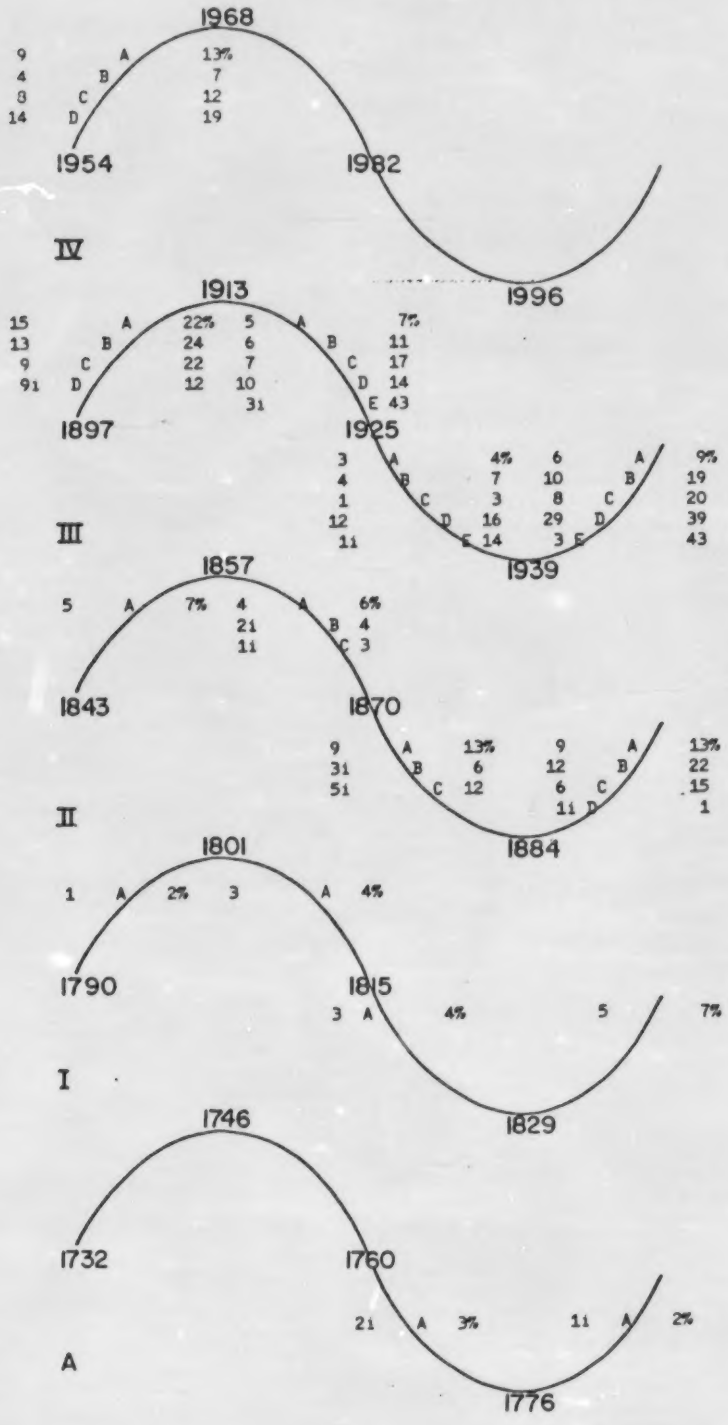
In the economic sphere, major innovations that provide new products require the establishment of new enterprises which will then become a "backbone" or a "carrying mechanism" for the next Kondratieff. In higher education, this process first took place with the founding of new types of colleges. For example, on the side of science, a minor innovation was "ignited" when the first chair of medicine was established in Philadelphia in 1765 during an economic depression (O). This was followed by a major innovation in the downgrade preceding the Prosperity phase of Kondratieff I, when a new type of "academic firm" developed in the form of medical colleges (N 9). Thereafter, even the original liberal arts schools fell in line by bringing into their curricula the new science courses (anatomy, botany, chemistry, and physiology) that had been initiated by the first medical colleges (N 11-14).

Kondratieff I (1790-1842). The first Kondratieff downgrade after 1800 saw the beginnings of the institutionalization of science in American higher education. The major innovation was the founding of a new type of academic firm (P), that is, a school of applied science and engineering such as the United States Military Academy (N 17), the Rensselaer School (N 26) in New York State, and the American Literary Scientific, and Military Academy in Vermont (N 25). Prior to the ignition of this major innovation, however, the upswing and peak of the first Kondratieff had seen growth in the number of science professorships (N 16), including the appointment at Yale of Benjamin Silliman who "revolutionized the American outlook on science" (Rudolph, 1977, p. 61) (N 18). College students were also admitted to scientific courses of study, although they received the less prestigious certificate rather than the baccalaureate degree (N 15).

At least five other innovations fostered growth in the sciences during that period. The first was the inauguration of the partial course non-degree program which permitted students to study what they wished, including the sciences (N 19 and M 20). The second was the introduction of a new four-year curriculum which paralleled the classical curriculum but provided for the senior year to be devoted to science (N 21, N 28, N 31-34). The third and fourth were, respectively, the founding of the American Journal of Science and Art (N 24) and the organization of undergraduate scientific

Number and Percent of New Academic Enterprises
RELATED TO HEALTH AND MEDICINE
Founded in Carnegie 1 - 4 Type Institutions

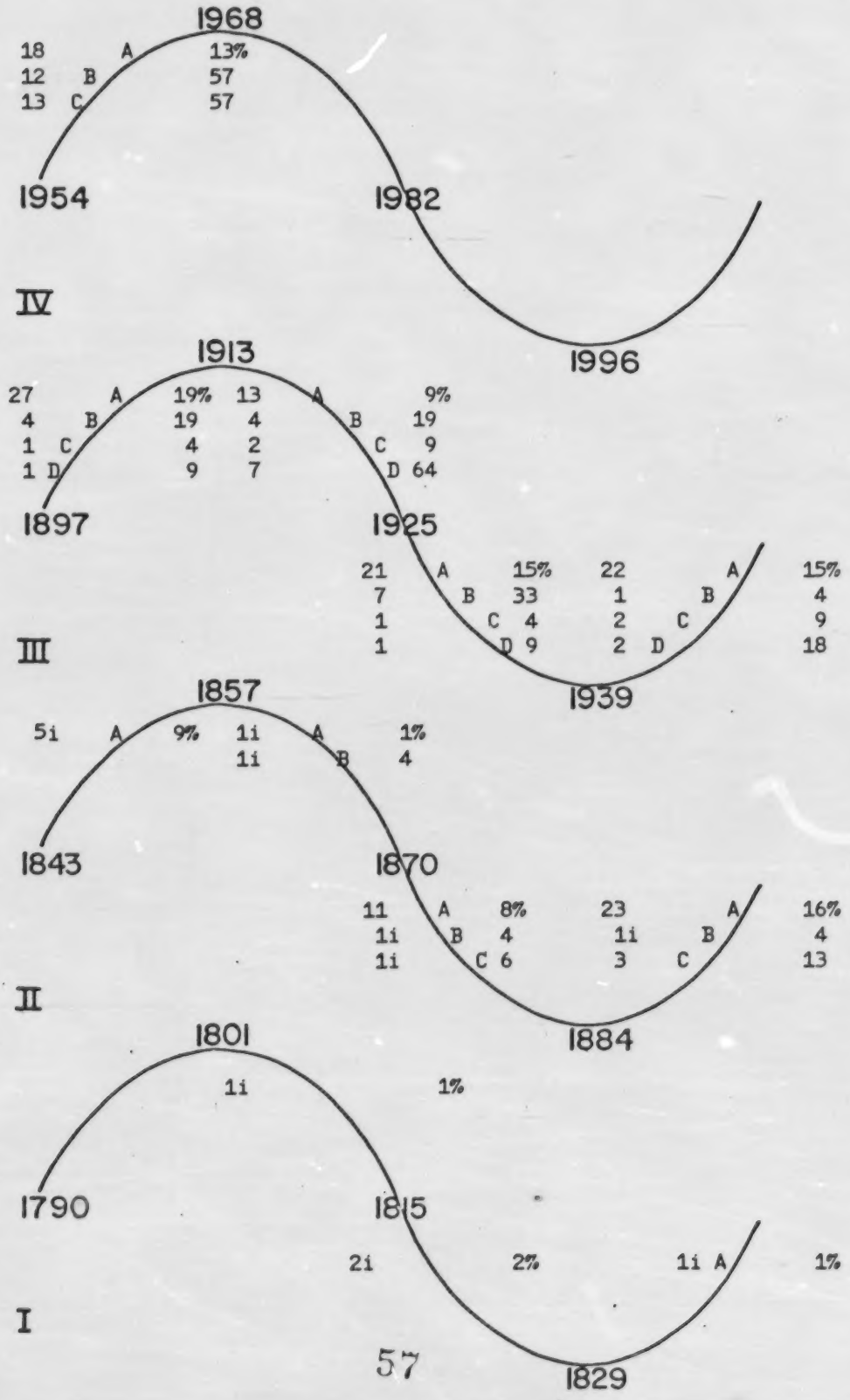
(A = 69 Medical Schools, B = 54 Pharmacy Colleges, C = 41 Dentistry Schools, D = 74 Nursing Schools, E = 7 Public Health Schools; 1 = Ignition of Innovation; Number on Left; Percent on Right)



Number and Percent of New Academic Enterprises
RELATED TO ENGINEERING, ARCHITECTURE, AND MINING
Founded in 118 Carnegie 1 - 4 Type Institutions

P

(A = 144 Engineering, Technology, and Applied Sciences Schools,
B = 21 Architecture Schools, C = 23 Mining Schools, D = 11 Engineering
Experiment Stations; i = Ignition of Innovation; Number on Left;
Percent on Right)



societies, such as the American Association for the Advancement of Science (founded in 1848) (N 23 and N 29). Both these innovations were important steps along the way to the professionalization of science and scientists in the United States. Finally, there was the beginning of the lyceum adult education movement which did much for the early popularization of science with such speakers as Benjamin Silliman (N 27). At the same time the number of faculty members in the sciences had expanded greatly, so that by 1830 many of the colleges had at least two professors of science (N 30).

Despite these competitive threats, however, those concerned with the liberal curriculum permitted only a few minor innovations in their area--i.e., the liberal arts: first, two more languages (Anglo-Saxon and German) were added to the course of study (M 29 and M 30). Second, the place of French in the curriculum was strengthened: the first professorship of French was established at Williams (M 17), French was required for admission at William and Mary and could be substituted for Greek in admissions at Williams (M 16). Union College permitted the substitution of four years of French for four years of Greek (M 18), and Yale offered French as a non-credit option (M 25). Third, Union also enabled students to elect courses when it introduced a partial-course policy in 1802 (M 20 and N 19).

Undoubtedly the developments in the sciences, along with the pressures of critics and reforms within the liberal arts ranks--including Philip Lindsley (Princeton, 1804), Presbyterian

clergyman and President of the University of Nashville from 1824; George Ticknor (Dartmouth, 1807), lawyer and first Ph.D.-trained (in Greek and German) academic in the United States and first Smith Professor of French and Spanish at Harvard, 1819-1835; James Marsh (Dartmouth, 1817), transcendentalist clergyman and President of the University of Vermont, 1826-1833; and Jacob Abbott (Bowdoin, 1820), Congregational clergyman, professor of mathematics and natural philosophy at Amherst, and pioneer of women's education--were so pervasive that "in the 1820's dissatisfaction became a movement" (Rudolph, 1962, p. 113). To counter this threat, the Yale corporation in 1827 appointed a committee of inquiry (M 27) whose famous report issued in 1828 (M 28) "became a classic statement in defense of the old order" which "put the weight of a great American college behind things as they were" and "stated the case for the classical curriculum in America with such finality that not until the next generation would another band of reformers assail the old course of study" (Rudolph, 1962, pp. 130-131).

But that is not to say that the adherents of the liberal arts were either indolent or asleep during the first Kondratieff. In fact, during the first half of the wave up to 1819, the number of literary colleges grew steadily, averaging .67 newly founded institutions per year (M 15, M 19, M 21). The major innovation underlying the trend, however, occurred in another American institution, the United States Supreme Court,

when it decided in the Dartmouth College Case that the publicly chartered, privately-controlled college was not subject to public control. The Court's decision was a judicial innovation in its effects on both the economy and higher education; it is said to have unleashed laissez-faire competition in both spheres. From 1820 to 1828 the pace of liberal arts college foundings increased with 12 new institutions beginning collegiate instruction for an average of 1.5 new colleges per year (M 24). Thereafter, college establishment was "undertaken in the same spirit as canal-building, cotton-ginning, farming, and gold mining" (Rudolph, 1962, p. 28). "The American people went into the American Revolution with nine colleges. They went into the Civil War with approximately 250. . . ." (Rudolph, 1962, p. 47). This phenomenal development during the Recovery of Kontratieff I and Prosperity of Kondratieff II took on the characteristics of a mania. Competitive denominationalism and sectarianism, state and local community boosterism, the evangelical zeal of westward-moving ex-New Englander educational missionaries, and personal ambition all played their parts (Rudolph, 1962, pp. 44-67).

In regard to the curriculum, however, all this activity amounted to little more than putting the same old variety of wine in hundreds of new bottles. The nature of the curricular grapes had not changed. Many attempts on the part of the new institutions to experiment with some of the reforms noted above were effectively squelched by the "inertia of social institutions," "the simple ordinary laziness of men," and that

"magnificent assertion of the humanist tradition" (Rudolph, 1962, pp. 134-163), the Yale Report of 1828, which "provided a rationale and a focus for comprehending a course of study that was wandering somewhere in no-man's land between inflexibility and disintegration" (Rudolph, 1977, p. 67).

The "manic" expansion of the literary college during the Recovery of Kondratieff I and Prosperity of Kondratieff II was accompanied by similar developments in a competing academic firm at the secondary level, the private academy. More than 6,000 of these secondary schools "taught ancient and modern languages as the badge of culture and social status" (Merle Curti, The Social Ideas of American Educators, Totowa, N. J.: Littlefield, Adams & Co., 1966, p. 22) between the early 1790s and 1850. In Schumpeterian terms, it might be said that it was due to the competing-down process that "perhaps as many as seven hundred colleges tried and failed before the Civil War" (Rudolph, 1962, p. 47). It was clear that the educational wares offered by the classical colleges had also become available at a lower-level institution, and probably at less cost to the consumer. In any case, only two minor victories for the cause of liberal education can be reported during this period: Ancient history was added to the college admission requirements in 1847 (M 33) and in 1846, when Harvard President Edward Everett found that the faculty were equally divided in their views on the elective system, he reduced the number of electives to three each in both the junior and senior years in a curriculum

that was completely prescribed consisting mostly of classical and liberal arts (M 32).

Kondratieff II (1843-1896). During the Kondratieff II Prosperity phase, science and scientists increased in status within the academic and professional worlds. At every level of activity there was expansion: New sciences and technologies were added to admission requirements--e.g., geometry (N 35); to parallel programs--e.g., chemistry (N 45); and to the undergraduate curriculum--e.g., agricultural chemistry (N 36) and engineering (N 44). By 1860 three-year parallel scientific programs existed in 25 colleges (N 48); new scientific and technological colleges had been started at Harvard and Yale (N 37 and N 38); a major innovation occurred with the opening, at Michigan State, of a new academic firm, i.e., the first agricultural college (N 43). To place a capstone on the entire structure, new degrees were awarded for non-classical scientific and technological curricula, e.g., B.Ph. (N 40) and B.S. (N 41 and N 42); and by 1860 the norm in the better institutions was four professors of science (N 47). In 1848, the American Association for the Advancement of Science was founded (N 39). A direct descendant of an earlier undergraduate scientific organization, it has since become the most significant professional scientific organization in the United States, if not the world.

As important as the previous upswing was for science and scientists, it was merely a prelude, an overture, to what was

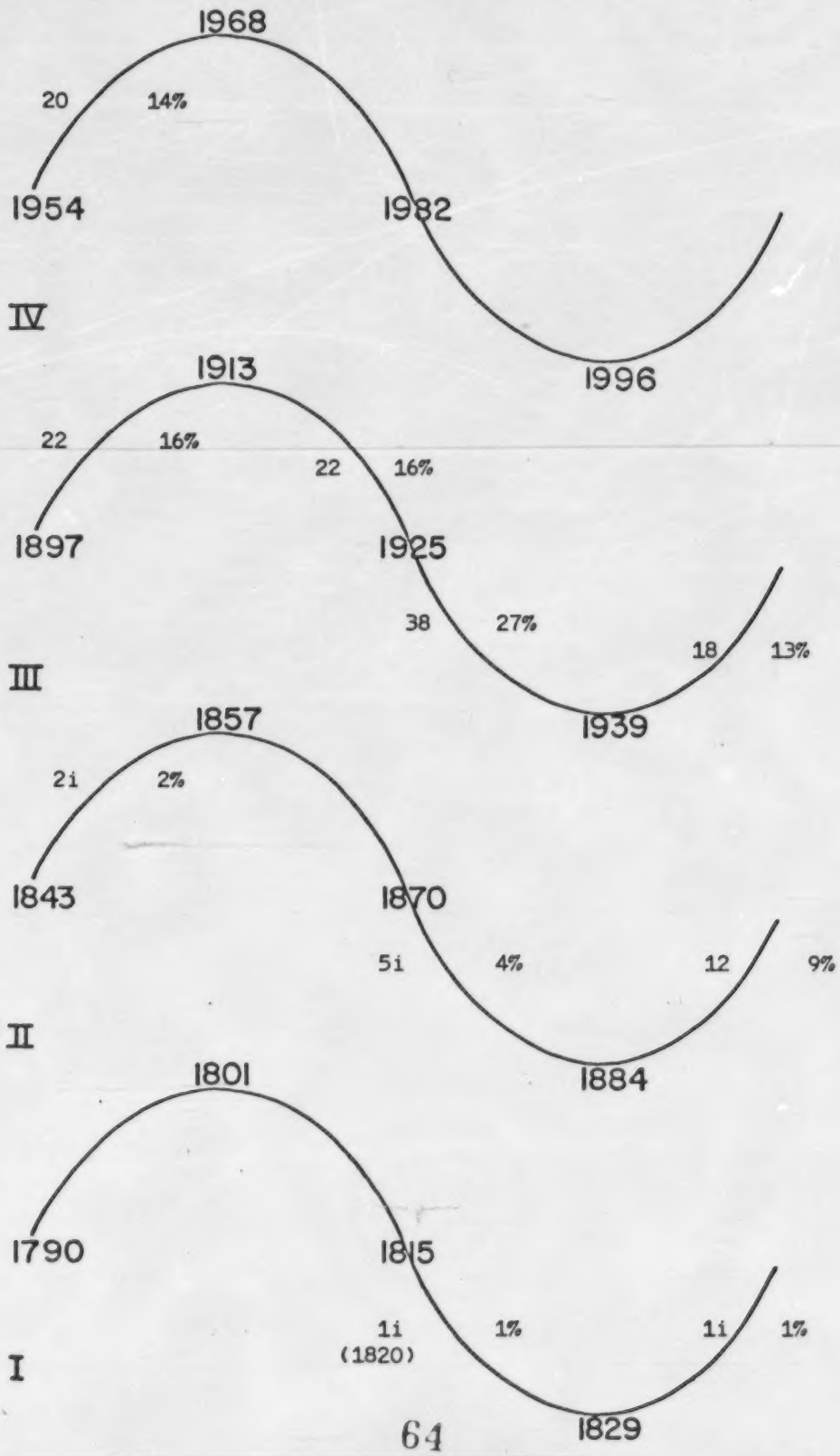
to follow in the downgrade of the second Kondratieff: namely, the institutionalization of science and technology in the academic and professional spheres. In the economic world the evolution of capitalism during this period saw an industrial revolution with major innovations clustering around three industrial complexes: petroleum, electricity, and automobiles (B). In the academic world of science and technology during the same period there were also three clusters of major institutional innovations: the opening of land-grant state colleges and universities (R), the establishment of private scientific and technical institutes, and the beginning of graduate schools (Q). In addition, just as in the economy "old" firms either adapted or died, so in the academic world, many "old" colleges transformed themselves into modern scientific, technical, and graduate colleges and universities.

The Morrill Act of 1862 (N 49) was in itself an innovation in federal legislation. From its provisions came the land-grant college movement which began with the opening of Cornell University in 1868 (N 54). Cornell became the model for the land-grant college system which started at least one college offering instruction in agriculture, mechanical arts, and military training in each state.

In 1865 Lehigh University (PA) was founded as a separate private scientific and technical institution funded by a gift from an industrial philanthropist. It was followed by a wave of

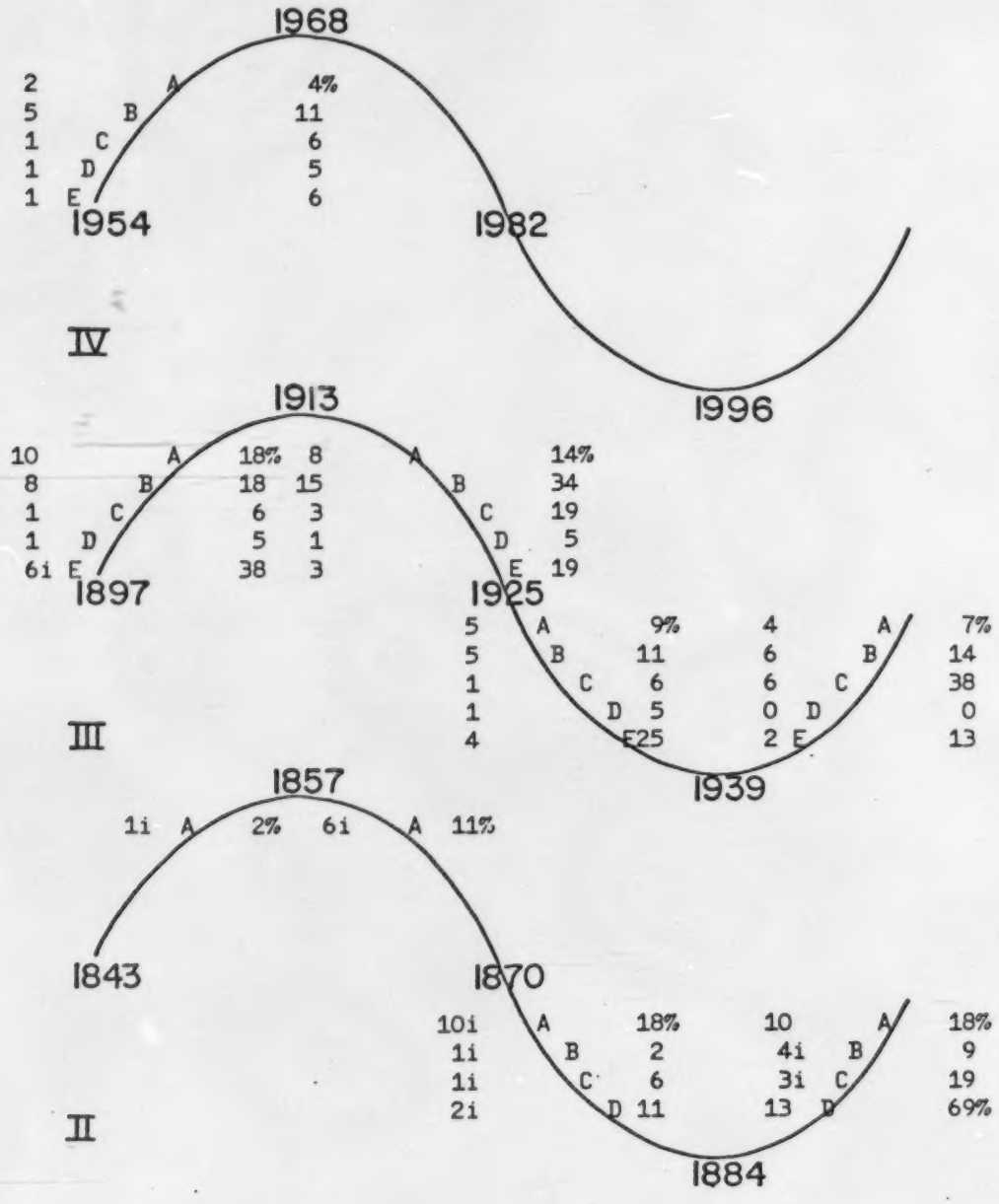
NUMBER AND PERCENT OF GRADUATE SCHOOLS
Founded in 141 Carnegie 1 - 4 Type Institutions

(i = Ignition of Innovation; Number on Left, Percent on Right)



Number and Percent of New Academic Enterprises R
RELATED TO AGRICULTURE
Founded in 62 Carnegie 1 - 4 Type Institutions

(A = 56 Agriculture Schools, B = 44 Home Economics Schools, C = 16 Veterinary Medical Schools, D = 19 Ag. Experiment Stations, E = 16 Forestry Schools; i = Ignition of Innovation; Number on Left; Percents on Right)



similar institutions started with gifts from private donors (N 52 and N 56).

In 1876 Johns Hopkins University (MD) opened as a graduate university modelled after the German research university with laboratories and seminars as modes of instruction (N 58). It became the flagship of a system of institutions for advanced teaching and research beyond the limitations of the traditional college; its express purpose was to "enlarge the boundaries of human knowledge by means of researches and investigations" (U.S. Commissioner of Education, Annual Report for 1870, p. 418). Johns Hopkins was followed by Clark University in 1888 and the University of Chicago in 1892. As was the case with almost every major innovation in higher education, graduate education had been under consideration long before it became institutionalized; there were many scattered pioneering efforts and abortive beginnings as far back as the 18th century. Even before Johns Hopkins, Clark, and Chicago, graduate schools had opened at Georgetown in 1820 and in at least three other institutions before the Civil War.

Several other innovations, favorable to science and scientists, also emerged during the Second Kondratieff downgrade. Three of these occurred within the academy itself: First, there was Harvard President Charles W. Eliot's call, in his 1869 inaugural address, for reform of the traditional colleges through the instrument of the elective principle (N 55). This was the opening gun in a struggle that lasted for at least 30

years, laying open the unified, prescribed, classical, liberal, and general course of study to the inroads of a vast array of practical, technical, and contemporary courses and programs of study, many of them related to science and technology. One result was that the period from 1870 to 1910 was one of curricular laissez-faire that fostered competition among fields of knowledge, subjects, students, and professors (John S. Brubacher and Willis Rudy, Higher Education in Transition, New York: Harper & Row, 1976, p. 114).

The second innovation was the establishment of land-grant college agricultural experiment stations with the passing of the Hatch Act by Congress in 1887 (N 61). The third was passage of the second Morrill Act in 1890 which provided an annual cash grant to land-grant institutions and opened the way for the education of Blacks (N 62).

Two innovations took place in the federal government. They included, first, the establishment of the Department of Agriculture in 1862 (N 50), leading to the beginning of organized research in agriculture, and, second, the chartering of the National Academy of Sciences in 1863 (N 51) for the purpose of fostering and supporting research in federal government agencies and departments.

A sixth significant innovation during this period, while located outside the academy, included many academicians: In the 1880s, a number of scientific and professional societies

came into being (N 59)--an important step in the professionalization of scientists and the sciences.

During the downgrade of Kondratieff I, the defenders of the classical liberal way, alert to the threats and attacks created by Eliot's elective reform, introduced a number of innovations designed to place controls on the elective system and "to discipline freedom" (M 44). Depending on the situation and conditions within a particular college, these innovations included, singly or collectively, such things as concentration, distribution, grouping of courses, honors programs, majors, minors, survey courses, course sequences, graded courses, tutorials, preceptorials, independent study, field studies, reading periods, seminars, and comprehensive examinations. Over the next century these controls were refined and became more and more sophisticated. In the meantime, especially during the 1870s and 1880s, the defenders of the old and new orders were fighting the "Battle of the Electives." Similarly, during the 1880s and 1890s the competition released by a free elective system precipitated the "Battle of the Classics." This all but destroyed the traditionalists' enrollments, reduced demand for their courses, and made them fear for the survival of their academic territory, especially when in the leading institutions their position was being constantly eroded by the lowering of prescribed standards (M 34, M 38, M 39, M 42, M 43, M 47).

One cannot help but wonder if there was any connection between these oftentimes emotional verbal and political struggles over academic territory and the great emotional upheavals and struggles over territories in other spheres during the Kondratieff II downgrade: e.g., the great fundamentalist evangelical religious awakenings which swept the country with Moody and Sankey in the 1870s and '80s; the contest between creationists and evolutionists; the struggles over economic territory when the Grangers and small businessmen attacked monopolistic freight rates during the 1870s and '80s; and the waves of labor violence of the 1880s and 1890s.

Similar to the pheonomenal rise of the private academies during the downgrade and Recovery of the first Kondratieff, the competing-down process in the liberal arts again reached the secondary school level during the second Kondratoeff trough and Recovery: The founding of a number of new boys' and girls' schools (M 46) signalled a revival of the preparatory and boarding school movement. Undoubtedly it was a natural result of the introduction and rapid spread, during the 1870s, of admission to college by high school certificate (M 35) that during the 1880s and '90s most colleges abandoned their preparatory departments (M 40), and that in 1892 the National Education Association Committee of Ten, with Harvard's Eliot in the chair, standardized the high school curriculum essentially as a college-preparatory liberal arts course (M 45).

Kondratieff III (1897-1953). At the beginning of the third Kondratieff during the upswing Prosperity, a number of attempts were made to redefine the liberal arts college and to set its standards in operational terms (M 48). To undertake these activities a number of associations and foundations were established, such as the Association of American Universities (1900), the College Entrance Examination Board (1900), the General Education Board (1903), the Carnegie Foundation for the Advancement of Teaching (1906), the American Council on Education, the National Conference on Standards, the Rockefeller Foundation (1913), and the Association of American Colleges (1914). In 1900 the College Entrance Examination Board standardized entrance examinations for colleges in an attempt to achieve curricular stability along liberal education lines. By 1908 25 eastern institutions were using these examinations (M 50).

During the Kondratieff III downgrade, the forces in the liberal arts that attempted to redefine liberal education in substantive terms initiated innovations all across the country. At least one of these can be considered a major development because it required the creation of a new academic firm designed to use a new method of production. This was Reed College (OR) which opened in 1911 with the inauguration of a general orientation course for freshmen (M 52). By 1926, 100 other colleges and universities had adopted, or adapted to, this innovation.

One of the oldest academic firms, Columbia University (1754), developed its Contemporary Western Civilization course in 1919 (M 54). This was the beginning of the modern General Education Movement, an event which spawned a number of two-year General Education and contemporary civilization courses elsewhere. By the 1930s more than forty colleges had adopted General Education programs, some of them highly distinctive and successful.

In 1922 Swarthmore College (PA) (1864) launched its honors program with the help of a $4,000,000 grant from the General Education Board (M 59). By 1930 there were almost a hundred such honors programs in the U.S.

In 1937 The University of Chicago's College adopted a four-year undergraduate General Education curriculum under the aegis of Robert Maynard Hutchins (M 61). Similarly, in 1937 St. John's College (MD), which had started as an academy in 1696, inaugurated a four-year Great Books curriculum (M 63), an idea which originated in 1920 when Columbia College's general honors course required the reading of one classic per week (M 55).

Various other devices and efforts to bring coherence, design, symmetry, and unity to the undergraduate curriculum were put in operation during this period. In the course of his quarter-century tenure beginning in 1910, Harvard's President Abbott Lowell introduced the tutorial system and the house plan (M 51). In 1913 Harvard initiated general comprehensive

examinations for seniors in history, government, and economics (M 53). In the 1930s and 1940s interdisciplinary and interdepartmental approaches to General Education--e.g., American Studies, American Civilization, American Culture--multiplied, bringing together such disciplines as history, political science, literature, sociology, and art history (M 60). This was followed in the 1950s by a proliferation of area studies (M 68). The recommendation in 1939 by Harvard's Student Council Committee on Education of a sharp turn away from the prevailing elective system (M 64) provided yet another sign of the tenor of the times.

During the downgrade and Recovery of the third Kondratieff some notable but ineffective expressions of support and sympathy for the general and liberal education cause came from important leaders in the field. It was almost as though the movement had run out of steam after an exhausting period of rebirth. Supporters included the New Humanists led, in the 1920s, by Harvard philosopher Irving Babbitt, who pleaded for a prescribed liberal education and attacked those colleges that catered to the practical and professional. In 1945 the Harvard report on General Education in a Free Society (The "Red Book") called for a unifying purpose and ideas resting on common beliefs as the basis for revitalizing General Education. President Truman's Commission on Higher Education issued a six-volume report, Higher Education for Democracy, urging the provision of a unified general education

for all American youth. They were as voices speaking in the wind. Results were few and meagre.

On the other hand, the upswing comprising the Recovery of the second and Prosperity of the third Kondratieffs brought several major innovations that created new academic firms related to science and technology: Nursing schools were established (O), as were home economics, veterinary medicine, and forestry schools (R). However, the main thrust of the period was the expansion of academic firms that had started in previous downgrades: Pharmacy and dentistry colleges grew in numbers, along with medical schools in existence since colonial times (O), schools of architecture and mining, agriculture (R), engineering and applied science and technology (P), and graduate schools (Q). In line with these developments the inaugural address of Nicholas Murray Butler at Columbia University in 1905 defined the function of the university as that of training for professional work.

During the downgrade and Recovery of Kondratieff III the continuing evolution of a mature industrial capitalism saw major innovations clustering around four industrial complexes: aviation, communications, computers, and space (B). Similarly, a number of major innovations in science and technology promoted by the federal government intimately affected the academic world: the National Research Council was established in 1917 (N 66); the Science Advisory Board, in 1933 (N 68); the National Cancer Institute, marking the beginning of organized medical

research, and the National Institutes of Health (N 69) in 1937; the National Defense Research Committee (1940) (N 70); the Office of Scientific Research and Development (1941) (N 73); the U.S. Atomic Energy Eommission (1946) (N 74); and the National Science Foundation (1950) (N 75). The impact of these events is reflected in the fact that total expenditures for organized research throughout the entire academic system rose from $18 million in 1930 to $27.3 million in 1940 and $225.3 million in 1950 (N 82).

Other events during Kondratieff III further enhanced the position of science and technology in the academy. E.g., the Smith-Lever Act of 1914 supported the establishment of agricultural and home economics extension services in the land-grant institutions. In essence, these activities popularized and disseminated useful applications of the sciences among farmers and their wives (N 65). In the 1930s the United States government funded extensive university building programs through the Works Progress Administration (WPA) and the Public Works Administration (PWA) which by 1939 were worth $200 million (N 67). The American Association for the Advancement of Science reported a membership of 21,000 in 1948, its largest roster since its founding in 1848 (N 72). The number of private and corporate industrial laboratories and research agencies grew from about 300 in 1920 to more than 2,200 in 1940 (N 72). By 1952 the total cost of research undertaken by industries was $2.5 billion, 56 percent of which was contributed by the federal government (M 76).

Kondratieff IV (1954-2010). The beginning of the Prosperity phase of Kondratieff IV coincided with the Soviet Union's launching of Sputnik. The shock caused by this event brought about expansion in the development of science and technology in the United States through the establishment of the Office of the Special Assistant to the President for Science and Technology in 1957, with J. R. Killian, former head of M.I.T. as the first incumbent (N 78); the passage of the National Defense Education Act in 1958 which earmarked increased federal expenditures for research and education (N 80); and the establishment of the National Aeronautics and Space Administration (NASA) in 1958 to plan, develop, and conduct the country's space explorations (N 81). By 1960 federal subsidies for organized research and scholarships in the academic system exceeded one billion dollars, with another $1.5 billion going to the institutions themselves. In 1962 federal funds accounted for 50 percent of the total expenditures of M.I.T., Stanford, Princeton, California Institute of Technology, and the University of California at San Diego (N 83).

By 1962 autonomous research organizations had developed connections with university scientists and their institutions: For example, Argonne National Laboratory entered into a relationship with the University of Chicago; the Jet Propulsion Laboratory, with the California Institute of Technology; the Lincoln Laboratory with M.I.T.; and Livermore, Lawrence, and Los Alamos Laboratories with the University of California,

the Stanford Research Institute, and the Institute for Social Research at the University of Michigan (N 83).

In 1963 the Higher Education Facilities Act provided 1.2 billion dollars over a three-year period. Between 1947 and 1967 research funds to medical schools increased to such an extent that they amounted to more than half of the total increase in the schools' expenditures, with 85 percent of the research costs being covered by federal funds (N 85). By 1972 federal funds made up 75 percent of research expenditures of all universities and 15 percent of their total budgets (N 82). While institutionally speaking, Kondratieff IV has been characterized as the Community College Wave, it could well be described as the Federal Government's Science and Technology Wave. In addition to this surge of activity on behalf of the sciences and scientists, the Prosperity phase of the fourth Kondratieff also saw expansion of all academic firms related to science and technology in health and medicine(O); in engineering, architecture and mining (P); in the graduate schools (Q); and in agriculture (R), all of which had "ignited" in earlier Kondratieff downgrades and Recoveries.

As for liberal education, during the Prosperity phase of the fourth Kondratieff, interest in the General Education Movement slowed perceptibly. For example, in 1954 Columbia College introduced a system of majors which restricted the General Education program and introduced specialization (M 69); in 1955 Howard Mumford Jones attacked General Education in an Atlantic

Monthly article (M 70); in the 1960s the quarter-scheduling system was initiated and expanded, requiring re-organization of curricula and courses in an attempt to speed up collegiate education for those who were primarily interested in vocational and professional training (M 71), causing Columbia sociologist Daniel Bell in The Reforming of General Education (1966) to urge the humanities and history to reduce the intellectual provincialism which he believed specialization had bred (M 74). His recommendations were not adopted. In 1971 Harvard came to permit substitution of two departmental courses for each general education course (M 75), and Amherst dropped all general education requirements (M 76).

On the other hand, those who would either reform or redefine General Education were active on a number of fronts: in the 1960s, Black Studies, Afro-American Studies, and Women's Studies came into being and proliferated (M 72). It appears that since the 1970s Women's Studies have continued to develop substantively and quantitatively but that Black Studies have not. During the 1960s and early 1970s, a number of major universities initiated innovative and distinctive general education colleges (M 73); most of these have since fallen on hard times. In 1973, in their Reform of Undergraduate Education (M 78), Levine and Weingart reported on 26 old and new experimental colleges' efforts to retard the decline of General Education. In the same year, Harvard's Student Council Committee on Undergraduate Education was established to reform the General Education program there

(M 76). Finally, in the late 1970s Harvard's Task Force on a Core Curriculum reported the need for a basic core general education curriculum (M 81). What will happen to these recommendations is not yet clear. Throughout the 1970s and '80s, The Chronicle of Higher Education and Change magazine regularly reported that many, if not most, of the colleges and universities in the United States were in one way or another examining their undergraduate general education programs with the view to revising, reforming, or redefining them.

It is clear that Kondratieff downgrades have been periods of great opportunity for innovation, for definition and redefinition, for revitalization and refurbishing in the liberal arts and general education as well as in the sciences and technology, and that Kondratieff upswings have been periods of great expansion. Already, almost halfway through the downgrade of the fourth Kondratieff, the economic innovations which will carry the Recovery of the present wave and the Prosperity of the fifth Kondratieff are discernible, clustering in the industries related to coal, nuclear fission, solar, tidal, and wind energy as well as in automation, computers, micro-electronics, robotics, and genetic engineering. However, it is also clear that since the ascendancy of science and technology have reached a dominant position in the American economy and its culture, liberal and general education have fallen on very hard times. The pattern of openings, closings, and mergers of academic enterprises typical of Kondratieff downturns is again in evidence: During

the 1970s more than 150 independent and denominational colleges closed their doors; at least 60 merged with more solvent institutions or "went public," and more than 50 new institutions were founded. (The Chronicle of Higher Education, "Fact File," 8/5/74, p. 5, and "Fact File," 12/18/72, pp. 7-8.)

The current status of the liberal arts college and general education is succinctly summarized in two statements in the Carnegie Foundation for the Advancement of Teaching's 1977 Mission of the College Curriculum:

> No curricular concept is as central to the endeavors of the American college as general education, and none is so exasperatingly beyond the reach of general consensus and understanding. (p. 164)
>
> General education is now a disaster area. It has been on the defensive and losing ground for more than 100 years. It represents the accretions of history more than the thoughtful concern for specialized current needs. (p. 11)

## Summary and Prospects

In the 17th century, the liberal arts had provided the primary cultural center of gravity and source of coherence and unity in the undergraduate curriculum. The first industrial revolution, riding on the back of power machinery, created the first Kondratieff Wave and resulted in growing dissatisfaction with the classical curriculum and the literary colleges. Despite their valiant defense by the Yale Report of 1828, general education and the liberal arts colleges declined.

The second industrial revolution, carried by the "railroadization" of America and coupled with the Darwinian

revolution, turned to the sciences as a competing cultural center of gravity for American higher education and its undergraduate curriculum as embodied in the university and its graduate and professional schools.

The third industrial revolution, under the impetus of electrification and petroleum and related industries, created the third Kondratieff Wave and strengthened the hold of science and technology on American society. Partly as a survival mechanism and partly as a backlash from its loyal adherents, but primarily in order to accommodate the new establishment and the elites that had risen as the result of industrialization, the General Education Movement was born to modernize liberal education by redefining its function as the basis for the survival of Western civilization and of the Great Books culture.

The fourth Kondratieff Wave, created by the post-industrial revolution with its carrying mechanisms of computer, communications, aviation, and space industries, has further solidified science and technology as the primary unifying factors for the culture and the curriculum. The redefinitions of general education which occurred in the third wave have survived, but barely. The liberal arts and western civilization thus are no longer our society's cultural center of gravity. Science and technology have become enthroned as the primary focus of culture. On the other hand, events such as the Three-Mile-Island crisis, the recombinant DNA controversy, and others have begun to dampen

popular enthusiasm for science. Religious revivals in traditionalist Islam and fundamentalist evangelistic Christianity fit the Kondratieff downturn well. The yearning for traditional cultural roots is growing. This calls for at least a resurgence, if not redefinition, of general education. It is impossible to predict the shape these developments will take; yet, there seems to be a trend in the direction of a return to the traditional values of general education. Our establishment elites have always had, and probably always will have, their own preparatory and independent schools and colleges to provide their sons and daughters with their "native" culture. However, now that universal higher education has become an expectation, entitlement, and right of the masses, the downgrade of Kondratieff IV is the time to "ignite" the innovations necessary to equip the members of a mass society for survival in a culture committed to science and technology.

## REFERENCES

American Council on Education. American Universities and Colleges. Washington, D. C. Ninth Edition, 1964, and Eleventh Edition, 1973.

Brubacher, John S., and Willis Rudy. Higher Education in Transition: A History of American Colleges and Universities, 1636-1976. New York: Harper & Row, 1976.

The Carnegie Foundation for the Advancement of Teaching. Missions of the College Curriculum. San Francisco: Jossey-Bass, Inc., 1977.

Levine, Arthur. Handbook on Undergraduate Curriculum. San Francisco: Jossey-Bass, Inc., 1978.

Rudolph, Frederick. The American College and University. New York: Random House, Inc. (Vintage Books), 1962.

_____. Curriculum: A History of the American Undergraduate Course of Study Since 1636. San Francisco: Jossey-Bass, Inc., 1977.

Schumpeter, Joseph A. Business Cycles, A Theoretical, Historical, and Statistical Analysis of the Capitalist Process. New York: McGraw-Hill, 1939.

Touraine, Alain. The Academic System in American Society. New York: McGraw-Hill, 1974.

Veysey, Laurence R. The Emergence of the American University. Chicago: University of Chicago Press, 1965.